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Circular No. 887

Shrub Plantings for Soil Conservation and Wildlife Cover in the Northeast

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and
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Soil Conservation Service

UNITED STATES DEPARTMENT OF AGRICULTURE
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The growing of vegetation has been recognized by the Congress as a means of effectuating a national policy for the control and prevention of soil erosion. During the past 14 years the Soil Conservation Service has gained considerable experience in the planting and use of shrubs for farm conservation plantings in the Northeastern States. Many plantings have been made on farms of cooperators in demonstration projects and soil conservation districts. Trial plantings, made on public lands in cooperation with other interested agencies, have been observed since 1939.

Much has been learned from the successes and failures of these plantings. The good results obtained in many plantings indicate the conditions under which the various shrubs may be expected to thrive, and the areas in which further plantings may safely be made. The complete or partial failures and the unsatisfactory results obtained in other plantings have shown the limits of adaptability of certain plants.

This circular sets forth the results of field tests on over 100 species of shrubs which have been planted under different climatic and soil conditions for conservation purposes in various parts of the Northeast. Instructions are given for the successful planting and care of many of these shrubs.

The aid of the following agencies has been invaluable in making and evaluating the field test plantings: Cornell University, Dartmouth College, Delaware Board of Game and Fish Commissioners, Maine Department of Inland Fisheries and Game, University of Maine, Maryland Game and Inland Fish Commission, Massachusetts Audubon Society, Massachusetts Department of Conservation, University of Massachusetts, New Jersey Department of Conservation, New York Conservation Department, Pennsylvania Game Commission, Pennsylvania State College, Syracuse University, Vermont Fish and Game Service, University of Vermont, and the West Virginia Conservation Commission.

Many farmers took part in observing the results of the plantings made on their farms. These observations were extremely helpful in evaluating the merits of the various shrubs for conservation and wildlife purposes.

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By Frank C. Edminster, *regional biologist*, and Richard M. May, *soil conservationist, Northeastern Region, Soil Conservation Service*

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INTRODUCTION

Many wild plants have been domesticated and developed as farm crops for the production of food and fiber. Some, like the commercially desirable trees of woodlands managed for timber production, have been favored and nurtured in their natural location through the application of cultural practices. Others, and by far the great majority, grow and flourish without man's intentional aid. The great group of plants called shrubs includes many kinds in each of these classes. (For the purpose of this discussion, some of the woody vines and smaller trees are included with the shrubs).

Among the shrubs cultivated as farm crops are the raspberries, grapes, filberts, currants, and others valued for their fruits and nuts, and certain shrub willows used for basket weaving. Hundreds of species of native and exotic shrubs are used in landscaping. Examples of the partial domestication of shrubs in their natural setting are the occasional, care-

fully controlled burning of blueberry patches to increase the fruit yield, and the culture of mountain-laurel kalmia, American bittersweet, and American holly for their decorative leaves and fruit.

Almost all progressive farmers use vegetative cover in some degree to control erosion. The growing of grasses and legumes for hay and pasture as part of a crop rotation and the planting and tending of forest trees are common examples. Although shrubs have been used occasionally for soil conservation in the past—as, for example, privet for cropland windbreaks —the opportunities for planting and managing shrubs for conservation purposes have been almost wholly neglected until recently. Interest in the use of shrubs has been greatly stimulated through the efforts of biologists to improve conditions for wildlife.

The use of shrubs on farms for the improvement of wildlife habitats, however, is often a secondary consideration. In fact, while shrub plantings almost always can be made to benefit wildlife, the plantings are usually done for other reasons. Examples are a multiflora rose hedge planted primarily to provide a fence around a pasture, or a farm windbreak of privet to prevent wind erosion on cropland. The extra birds and bees attracted are a byproduct. Most farmers desire benefits in addition to wildlife habitat if they are to establish and care for shrub plantings.

In the planting of shrubs for conservation purposes, considerations of land use and erosion control are paramount. But it is not enough that the shrubs shall aid in controlling erosion or improve the environment for wildlife, important as these goals are. The value of the plant products, the indirect effect of plantings on the surrounding land, and the nonmaterial benefits which they contribute to better living should also be taken into account.

The species selected for farm plantings preferably should have several uses and values. Those that produce fruit or nuts for home use have an obvious appeal. Many are attractive and improve the landscaping of the farm. Some furnish cut materials for indoor decoration. Others provide food and shelter for desirable kinds of wildlife or for bees or other useful insects. The form, height, width, density, growth habits, and other characteristics of the various plants have a bearing on wind and water conditions and on adjacent growing crops.

WILDLIFE HABITATS ON THE FARM

A good habitat is a necessity for the production of wildlife. With it, suitable game animals have a chance to produce huntable populations. With a poor or unfavorable habitat, game inevitably will be scarce or absent and hunting will be poor. All other aspects of game management are secondary, for without a good habitat no game crop worth managing can be produced and maintained.

Upland habitats on farms may be divided conveniently into four classes—crop fields, grasslands, woodlands, and brushy areas. All are important to most farm-game species, although the relative use made of each kind of habitat varies with the kind of animal. The carrying capacity of a farm or any area of farm land for wildlife is determined largely by the presence and extent of these different habitats and by the main habitat attributes—*quality*, or the character of the cover; *quantity*, the

amount of cover; and *pattern,* the arrangement of the units of cover with respect to one another.

The opportunities to improve the wildlife carrying capacity of farm land must be evaluated by considering these habitat factors in the light of regular farm-operation requirements. On crop fields and grasslands, the lands on which the farmer primarily makes his living, every farming operation—plowing, seeding, cultivation, mowing, fertilizing, crop rotation, seed selection, stocking of animals, harvesting, and so on—is aimed at crop production. The time each operation is performed, the tools used, and the techniques followed on such lands are all planned to give the best yields of quality products. Even when the conventional methods of farming are modified to conserve the soil and maintain its fertility, the governing interest generally continues to be the production of money-making crops. In achieving this end, the carrying out of regular farming operations of necessity limits to some degree the usefulness of crop lands and grass fields for wildlife. Field cropping under certain conditions may even be highly damaging to the wildlife already using the lands.

Crop and grass fields, nevertheless, are important habitats for many farm-game species. Furthermore, the productivity of such lands for wildlife usually may be increased without interfering with the production of crops or grass. The means of doing this depends upon the extent to which supplementary conservation practices may practicably be employed in support of the regular conservation operations. Various types of supplementary practices are applicable on croplands and grass areas. Those that utilize shrubs often provide the greatest benefit to wildlife.

Farm woodlands, especially areas adjacent to crop and grass fields, are valuable farm-wildlife habitats. Since the management of such woodlands is aimed primarily at the production of wood products, wildlife considerations are of secondary importance and improvement in the habitat will depend mainly upon the incidental benefits resulting from woodland management. Usually only minor adjustments can be made in the customary woodland improvement and harvesting methods in order to favor wildlife. Fortunately, most measures of proper woodland care and cutting result in reasonably good wildlife habitats. But woodlands in general present relatively few direct opportunities for improving the farm-wildlife habitat.

"Wildlife land," by which is meant areas of farm land better suited for production of wildlife than for other uses, includes aquatic areas and places primarily suited for shrubby cover. Many farms have lands available for such purposes.

FAVORABLE SITES FOR SHRUB PLANTINGS

Brushy cover has particularly high value for wildlife. In open fields it furnishes storm shelter and escape cover for farm species. In or adjacent to woodland it provides openings and furnishes food for woods animals. It may occur naturally in association with young trees and rank herbs, or it can be developed through shrub plantings. Areas suitable for brushy cover can become the key to a productive habitat pattern. Regardless of the use made of shrub cover, its management can and should be directed to making the whole farm produce the best possible wildlife crop.

Experience on many thousands of farms has shown conclusively that several types of shrub-cover sites and uses are not only acceptable to the farmer but serve his best interests. The most common uses for shrub plantings are as follows:

1. *Woodland field borders*—the zone of poor crop yields at the edge of tilled fields and pastures next to woodland, generally in a strip 20 feet or more in width.

2. *Hedges and living fences*—rows of managed shrubs extending across crop fields or along the boundaries of crop fields and pastures; usually made up of one or two rows of shrubs laid out on the contour.

3. *Windbreaks*—strips of trees and shrubs, or shrubs alone, usually consisting of from 1 to 10 rows running in lines at right angles to the direction of prevailing winds that might blow away the soil or cause damage to crops, buildings, roads, and livestock.

4. *Streambanks*—the bank slopes of stream channels across open lands.

5. *Odd areas*—spots in open fields that are unsuitable for cropping or grazing due to excessive steepness, wetness, soil acidity, stoniness, lack of topsoil, or other unfavorable condition. Such areas are usually small or narrow and include gullies, roadbanks, spoilbanks resulting from ditching or mining, rock outcrops, sinks, and other areas better suited for wildlife habitats than for other land uses.

JUDGING THE SUITABILITY OF SHRUBS FOR USE IN CONSERVATION

Until recently, the planting and care of shrubs was confined mainly to the fields of horticulture and landscape gardening. Management methods were intensive and usually directed toward the attainment of a single objective such as fruit or nut production in orchards and decorative effects in landscaping. Each plant was given individual attention—set with care, cultivated, fertilized, pruned, and sprayed as needed.

Only a small part of that knowledge is applicable to the more recent conservation uses. The establishment of field borders, hedges, windbreaks, and similar conservation plantings involves such large quantities of plants that little time can be devoted to the care of single plants. Management must be on a broad scale rather than intensive. Certain cultural treatments such as pruning or spraying are generally impractical. Most of the horticultural species and varieties have failed when used in field plantings mainly because it is impractical to give individual plants such care.

Only a few kinds of shrubs are suitable for planting on field sites. Most species are unadapted to such use for a variety of reasons. Important criteria that may be used to judge the suitability of a shrub for conservation planting are as follows:

1. *Hardiness.*—The shrub must thrive in the climate where used. Species that winterkill, those that flower so early or so late that frosts prevent fruiting, and those which otherwise are unadapted to temperature and moisture conditions cannot be widely recommended.

2. *Site adaptability.*—The most useful plants are those that can thrive in a variety of soils—poor as well as fertile, dry or wet, acid or alkaline, etc.

3. *Growth habits.*—Speed of establishment is important, especially when an early ground cover is needed to stabilize badly eroding areas. Rapid establishment also enables the shrubs themselves to compete successfully with the natural reproduction of other plants. The plant should fruit and reproduce quickly and effectively enough to make a complete cover on the planted site, but not so aggressively as to invade adjacent cropland, pasture, or woodland areas and become a nuisance. Ability to resume growth by suckering or sprouting after being burned, cut, or browsed is a valuable trait. Once established, the shrub must compete successfully with other plants and require a minimum of culture for its maintenance.

4. *Form and character of growth.*—The plant should have a form and character of growth suitable for the purpose it is to serve. It may need to have dense branching and foliage for windbreaks; dense growth combined with thorniness for living fences; a trailing habit for steep banks; limber, strong stems for streambank use; low height for hedges; or other characteristics for special uses. The root system should be deep or very fibrous to hold the soil together. Shrubs with deciduous leaves that quickly build a good layer of ground litter are helpful in controlling soil erosion. Evergreen foliage is often desired. Usually the plant should grow to a height that is attractive, or at least not out of harmony with its surroundings.

5. *Use of products.*—Shrubs that produce food for human use, pollen or nectar for honeybees, materials for decorative use in the home or for basket making, tying materials for use in vineyards, or other directly useful products have a great advantage over those that lack such values.

6. *Wildlife habitat.*—Improvement of conditions that favor production of more kinds and numbers of useful wildlife is highly important. Plants that furnish good food, especially for winter use, and those that provide good shelter for nesting, protection from weather, and a means of escape from enemies should be used wherever possible. Certain species of plants are more beneficial than others for particular kinds of wildlife.

7. *Lack of obnoxious qualities.*—Species poisonous to man or livestock and those that give off bad odors, harbor serious diseases or insect pests, or have other qualities likely to make them pests must be avoided under most circumstances, even if they have other good characteristics.

8. *Availability.*—Plants or seed must be easy to obtain at reasonable cost. For plants, this usually means that plants of good grade for field planting must be readily grown in the nursery in a year or two.

9. *Ease of establishment.*—The simpler the job of starting the plantation, the better. Species which can be established by cuttings, direct seeding, or small-size planting stock are desired; likewise those which can be planted by the use of ordinary field planting techniques. Using kinds that can be depended on for high survival makes costly replacement planting unnecessary.

HOW THE INFORMATION ON USE OF SHRUBS FOR FARM CONSERVATION PURPOSES WAS OBTAINED

The first recommendations for the use of shrubs in soil conservation work were based on the known characteristics of plants growing naturally or in home plantings. Emphasis was placed on shrubs reported to be

valuable for the wildlife food they offered, and on those that seemed able to thrive under highly unfavorable conditions. It was supposed that plants with such a combination of characteristics would both control erosion and improve conditions for wildlife.

Seeds of various shrub species were collected and planting stock was produced in Soil Conservation Service nurseries. From 1935 to 1938, shrubs of 67 different species were used on farms cooperating with erosion-control demonstration projects in the Northeastern States. The quantities used varied greatly and the bulk of them was made up of relatively few species.

The early field plantings were in no sense comprehensive. Since erosion control was almost the sole objective of conservation practices, the plantings were designed primarily for the purpose of determining the effectiveness of the plants in achieving this end. There was, furthermore, little variety in the selection of planting sites. Grasses and legumes were planted on areas on which these plants appeared to have any reasonable chance of success. Trees usually were planted on poorer sites. Shrubs were used on areas where nothing else supposedly was able to grow, usually gullies. These shrubs were planted under the worst possible conditions. Since the scope of the field work was more or less restricted, and the planting sites themselves were confined to areas of predetermined quality, the results were of limited usefulness. After the first few years, it was apparent that a more systematic evaluation of the merits of the potentially useful shrubs was needed to find the better species and eliminate those not measuring up to standards.

Accordingly, in 1939, a number of the earlier plantings were selected for observation of results. They were chosen at random, mainly from among the 1935–38 plantings but with due consideration to accessibility and geographic distribution. The plantings were on 244 farms located in Vermont, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, and West Virginia. Many measurements were made on these plantings at intervals during the succeeding years. Later plantings on other farms in these 8 States and in Maine and New Hampshire provided additional information.

Also, in 1939, a series of field test plantings was begun on public lands and in cooperation with interested agencies, primarily State wildlife organizations and colleges, at 35 stations in 10 States. The plantings generally were in small plots containing 10 to 100 plants of a kind in one location. Establishment and performance records were regularly kept, and although not more than a few thousand plants of any species were used, much valuable information was obtained.

Plants which showed promise in the initial tests were grown in increased quantities and distributed to selected farmers in soil conservation districts for extended evaluation through field trials. Thus, through experience, the proper uses of shrubs in conservation work and the true value of shrubs for different uses were gradually developed.

Present recommendations are based on the observed results of all these plantings. Evaluations are based on survival counts, measurements of height growth, rapidity of ground coverage, records of fruiting and hardiness, and other factors.

The shrub plantations now being made in the Northeast consist mainly of seven species. Sixteen other species are suitable for limited or special uses. Both of these groups are discussed in detail in the following pages.

Subsequent sections deal with shrubs which the trials have shown cannot be recommended for field use in conservation plantings, and shrubs for which no definite conclusions as to suitability can be drawn until tests now being carried on have been completed.

METHODS OF ESTABLISHING SHRUB PLANTINGS

Selection of Species

The first requirement for successful planting is the proper selection of species. The plants used must be suitable to the climate, soil, and other environmental conditions, and fit the purpose of the planting.

Site Preparation

Good site preparation is essential. For best results, the site should be well prepared by plowing and harrowing; in fact, such preparation is required for direct seeding of certain species like the shrub lespedezas. For seedling plantings such thorough preparation may not always be practicable. In this event either a single- or double-plow furrow should be made, preferably the latter. On sloping land, the furrows should be on the contour. The distance between planting furrows will depend upon the extent of side growth naturally made by the shrubs in the planted rows. The seedlings should be planted in the furrow channel if the soil is dry or well drained; in the furrow ridge if the soil is poorly drained.

If the topography will not permit furrowing, or if furrowing equipment is not available, the next best site preparation is thorough scalping of the sod. All surface vegetation should be removed by mattock or shovel from a space of at least a square foot for each plant. Thus each seedling will be in a bare spot free from the early competition of other plants. Mulching the bare spot with sawdust or wood chips will give added protection. *Shrubs should never be planted directly into grass or weed sod.*

Planting Method

Center-hole planting is best. A hole is dug in the scalped earth, furrow, or bare ground and the seedling is placed in the middle of the hole with the root collar at ground level. The roots should be well spread out and not doubled up. Loose dirt, free from sod clumps, is then packed around the roots from all sides and tamped in firmly.

Planting Stock

The seedlings should be thrifty nursery-grown stock with a stem diameter of $\frac{1}{8}$ to $\frac{1}{4}$ inch and a top growth of 6 to 15 inches. The roots should be well developed, fibrous, and at least 6 inches long. Tall seedlings are preferable, but for most species plants with only 6 inches of top growth are satisfactory provided they have the required stem diameter and root growth.

Time of Planting

The best time of planting is early spring as soon as the ground is mellow. Planting later in the spring is satisfactory so long as the planting stock is not in leaf. The more fully the buds have developed, the greater must be the care used throughout the entire planting operation.

Planting may be done at any time in the fall or winter after the seedlings have dropped their leaves provided the ground is not frozen. Fall and winter planting can be done successfully only in light, open soils.

Care of Seedlings

Young shrubs are very tender and should be given proper care from the time they are lifted at the nursery until they are planted. Above all, they must be kept moist and never allowed to dry out. In packing the shrubs for shipment, the plants should be bundled in wet peat moss with the plant tops at the ends of the bundles and the roots in the middle. The bundles should be sheltered from the hot sun. Bundles in common-carrier transit should be marked "Keep Cool" and kept out of heated rooms.

Shipments of planting stock should be unpacked promptly upon arrival. Each bundle of seedlings should be opened and the plants spread out in a heeling-in trench in a cool, shady, well-drained but moist location, then covered with soil and packed firmly. They should also be covered with burlap or wooden racks if the heeling-in site is open to the full sunshine at any time.

The plants should not be removed from the heel-in bed until just before planting, and then taken up only in small lots. They should be carried in pails containing enough water to keep the roots wet.

Some shrubs should be pruned back to 3-inch stubs either before or just after planting. Of the seven species recommended for general use, those which should be pruned when planted are multiflora rose, silky cornel, tatarian honeysuckle, purple-osier willow, and bicolor lespedeza.

Care After Planting

The establishment and development of shrub plantings should be speeded up wherever possible by proper cultural treatment. Cultivation once a year for 1 to 3 years after planting will contribute most to rapid growth. The plants may be fertilized to speed their growth, but since fertilization may stimulate the weeds to grow faster than the shrubs it should be done only in conjunction with cultivation or mulching in order to reduce weed competition.

Some shrubs develop as single-stemmed plants at first. After 1 or 2 growing seasons such plants may be pruned back close to the ground during the dormant period, thus forcing them to produce more stems and bush out.

NATURAL SUCCESSION IN THE DEVELOPMENT OF SHRUB COVER

Although this circular is concerned primarily with the establishment of shrubby cover through cultural practices, the importance of other means of developing stands of shrubs is also recognized. In the Northeastern States, most open land will revegetate in time with woody plants through natural plant succession if protected from the plow, fire, livestock, and axe. Some of these plants will be shrubs.

It would be possible in many places to let the vegetation develop naturally until shrubs and trees dominate the site, and then force the formation of a complete shrub cover by cutting out the trees. The shrub stage could then be maintained by the occasional removal of any trees that invade the stand.

This procedure is not recommended for all woodland edges for several reasons. The kinds of shrubs that develop through chance may not suit the needs of the landowner; or, like poison ivy and other noxious species, may even be detrimental in some respect. The uniformity of growth desired for some purposes, such as hedges and windbreaks, is rarely obtained through natural seeding. The work of cutting back or removing trees which become too large or tend to take over to the exclusion of shrubs may be difficult and not always economically feasible.

Furthermore, a mixed shrub and tree stand that is allowed to grow up naturally, possibly to be gone over with an axe at some indefinite future time to convert it into a good shrub cover, is apt to remain neglected. Because such a stand has required little or no investment, little value is usually placed upon it. Cattle are likely to be turned into it when drought makes forage scarce elsewhere. Even when the farmer deliberately sets out to work over such a stand with the intention of selectively cutting out trees and favoring shrubs, he faces technical difficulties. Since the work is usually done in the winter after most plants have shed their foliage, it is necessary to distinguish dogwood from maple, hazel from oak, and so on, without having the leaves to aid in identifying the species. Many farmers lack the information needed for making these distinctions. Attempts to develop shrub cover by strictly natural processes thus may be less certain than planting to bring desired results, either as to kind of plants or objectives sought.

Nonetheless, the method of natural succession instead of planting may be recommended under some conditions. Where crop fields are small and the amount of land adapted to cropping is very limited, as in parts of New England, shrub borders may often be developed by trimming out the edges of the woods rather than by planting the edges of the fields. The area thus saved for crop use is worth the extra time and effort required. Similarly, where natural stands of desired native shrubs are already present in borders, hedgerows, and odd areas, the cutting of overtopping trees may be all that is needed to make such areas as good as any that could be planted. Some of the desirable native shrubs are difficult to grow in a nursery and do not transplant easily. Shrubs of this type can be used in the development of an effective cover only through the cultural improvement of natural stands.

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SHRUBS RECOMMENDED FOR GENERAL USE IN FARM CONSERVATION PLANTINGS

Seven different shrubs have proved most successful for farm conservation planting in the Northeast. These are listed alphabetically in the order of their scientific names, as follows:[1]

Cornus amomum	Silky dogwood
Elaeagnus umbellata	Autumn olive
Lespedeza bicolor	Bicolor lespedeza
Lonicera tatarica	Tatarian honeysuckle
Myrica carolinensis	Bayberry
Rosa multiflora	Multiflora rose
Salix purpurea	Purple-osier willow

These species comprise the vast majority of planting materials used at present in the Northeast on recommendation of the Soil Conservation Service. They have been thoroughly tested and have proved their suitability and worth.

As previously mentioned, the success of shrub plantings was determined on the basis of factors including survival rate, growth, form of plant, rate of spread, vigor, and quantity of fruit production.

Survival was considered to be *excellent* where 85 percent or more of the plants lived, *good* where 70–85 percent lived, *fair* where 40–70 percent lived, and *poor* where less than 40 percent lived. Well-distributed survival of 70 percent or more is considered enough for the development of a good stand.

The terms *excellent, good, fair,* and *poor* are used also in describing the degree of success attained with respect to several of the other evaluation factors mentioned.

Plantings were assumed to have attained site dominance when competing species had either been eliminated or suppressed and were unable to establish themselves securely enough to crowd out the planted species.

Silky dogwood (*Cornus amomum*)

Silky dogwood is a native plant ranging from Maine to North Dakota and south to the Gulf of Mexico. It is a medium-sized shrub, 6 to 12 feet high, with purplish-red branches that change to green and brown with age. The brown pith of the older stems distinguishes this species from its close relative, the red-osier dogwood, which has red stems and white pith. The leaves are in pairs opposite each other on the stems. They are oval, pointed, 2 to 4 inches long, and have short petioles. The shrub blooms in June with round, flat-topped clusters of small, yellowish-white blossoms 2 to 3 inches across. The round, pale blue fruit ripens in September and falls to the ground within the next month or two.

Although the shrub is erect in growth form, the branches have a tendency to spread out, especially if the plants are widely spaced. It sends

[1] Scientific and common names of plants, with a few exceptions are those given in "Standardized Plant Names," second edition, prepared for the American Joint Committee on Horticultural Nomenclature. J. Horace McFarland Co., Harrisburg, Pa. 1942.

FIGURE 1.—Silky dogwood, one of the most adaptable shrubs, makes an excellent wildlife border for old woods or new tree plantations. Here it forms a border with nannyberry viburnum and wild crabapple. The trees will not compete with field crops grown in the cultivated part of the field. Farm game finds cover and food in borders of this type.

out stolons and forms fairly dense thickets, but is not aggressive enough to spread into cropland, pasture, or woods (fig. 1).

Survival in conservation plantations was uniformly high. Of 59 plantings on which records were kept, 37 had excellent and 19 had good survival. The few failures were due to excessive grass competition or to the barrenness of the soil in the sand-blown area in which one of the trial plantings was situated. No differences in survival could be attributed to geographic location, the results generally being much the same from Vermont and New York to Delaware and West Virginia. There is some evidence, however, to indicate that the shrub may not be well adapted to the lower coastal plain area.

Height-growth rate was good in most plantings, the general average being 4 to 5 feet in 5 years followed by a slowing down of growth in later years. Plantings 12 or 13 years old had reached fully mature heights of 8 to 12 feet on the better soils, but only 5 to 6 feet on certain poorly drained acid soils in New York. Most plants were well branched and of good form. The largest growth was in a border near Quarryville in southeastern Pennsylvania where the stand grew to a height of more than 12 feet in 11 years, a few plants reaching 16 feet. A 7-year-old planting on a road bank near Whitehall, Md., averaged 8 feet, some plants exceeding 9 feet. The best planting in New York, on a streambank near Haskinsville in Steuben County, reached 7 feet in 7 years in spite of severe competition with many other species.

Some plantings attained heights of only 2 or 3 feet after 5 to 7 years, apparently because of poor planting stock or careless planting, although

in a few cases the slowness of growth was due to droughty or sterile soil.

Browsing by rabbits or deer may severely retard growth, and if cattle are allowed access to the plantings the animals keep the plants trimmed down to stubs.

Fruit usually was first produced the fourth or fifth year.

Almost all plantings dominated their plant communities in 10 years, and about one planting in four attained site dominance within 7 years. It is believed that silky dogwood generally will eliminate competing plants within 5 to 7 years if sound planting techniques including proper initial handling and proper spacing of the plants are followed.

Although silky dogwood occurs naturally on moist sites, plantings on well-drained soils are about as thrifty as those in wetter places. In fact, this plant is well adapted to a variety of soils. Only droughty soils seem unsuited to it.

It is used chiefly in border plantings, wildlife areas, and on streambanks. Its values are largely in the form of wildlife cover, shelter of a rather open-branched type, and source of fall food. The new-wood stems are useful for indoor decoration, their deep-red color making a decorative addition to other vase plants.

Silky dogwood is easy to grow in the nursery and to establish on the farm. One- or two-year-old nursery-grown seedlings are recommended. The top growth of nursery stock should be pruned back to a height of 3 to 6 inches just before planting. Like most hardwood shrubs, competition from other plants retards its early growth. Hence, plantings should be made in plowed furrows, on the contour if possible; or, if in grassy areas, in spots from which the sod has been removed for at least a square foot per plant. Spacing should be 3 to 4 feet.

Although the fruit is not a primary food of any animal, it helps to make up the total fall food supply of many birds and mammals. The fruits are eaten at that season by at least 11 species of birds including bobwhite, ruffed grouse, and ring-necked pheasant.

Autumn olive (*Elaeagnus umbellata*)

Autumn olive is an upright shrub introduced from China. It grows to a height of 8 to 14 feet and has somewhat spreading branches which may be slightly spiny. The bark of the new wood is yellowish-brown flecked with silver. The leaves are elliptical, about 2 to 3 inches long, and usually have a crisped margin. The new leaves have scattered silvery scales on the upper side, and are quite silvery and have scattered brownish scales on the lower side. The yellowish-white, fragrant flowers are about ½ inch long and resemble honeysuckle flowers in form. They bloom in May and June. The fruit is red, almost round, about ¼ inch in diameter, and usually coated with small silvery scales. It ripens in September and October but usually does not remain long on the plant because it is much desired by birds. The branches are generally stripped of their fruit before winter (fig. 2).

A 1939 planting made in an abandoned field on Pennsylvania Game Lands in York County, Pa., had excellent survival. Plants averaged 97 inches in height growth in 6 years and 12 feet in 11 years. Heavy crops of fruit were produced beginning with the third year. Branches within reach of rabbits were injured by browsing. The plants were very bushy

FIGURE 2.—*A*, The tall autumn olive is suitable for use in borders next to woodlands. *B*, The fruits are eaten by many birds in autumn.

and thoroughly dominated the site. The stand was appreciably thickened by young seedlings which came up in nearby bare spots.

In a planting made on a raw, active sand blow near Jericho in northern Vermont in 1937, the survival, though only fair, was exceptionally good considering the poor quality of the site. Although height growth in 8 years averaged only 5½ feet, some plants reached 9 feet. Plant form and fruit crops were remarkably good. The plants seemed to be fully hardy in this cold area.

In view of the useful qualities exhibited by the shrub in these early plantings, widespread test plantings were made over the Northeast beginning in 1944. Observations over a period of 3 to 7 years confirmed the earlier results. Of 15 such plantings, only 2 were not success-

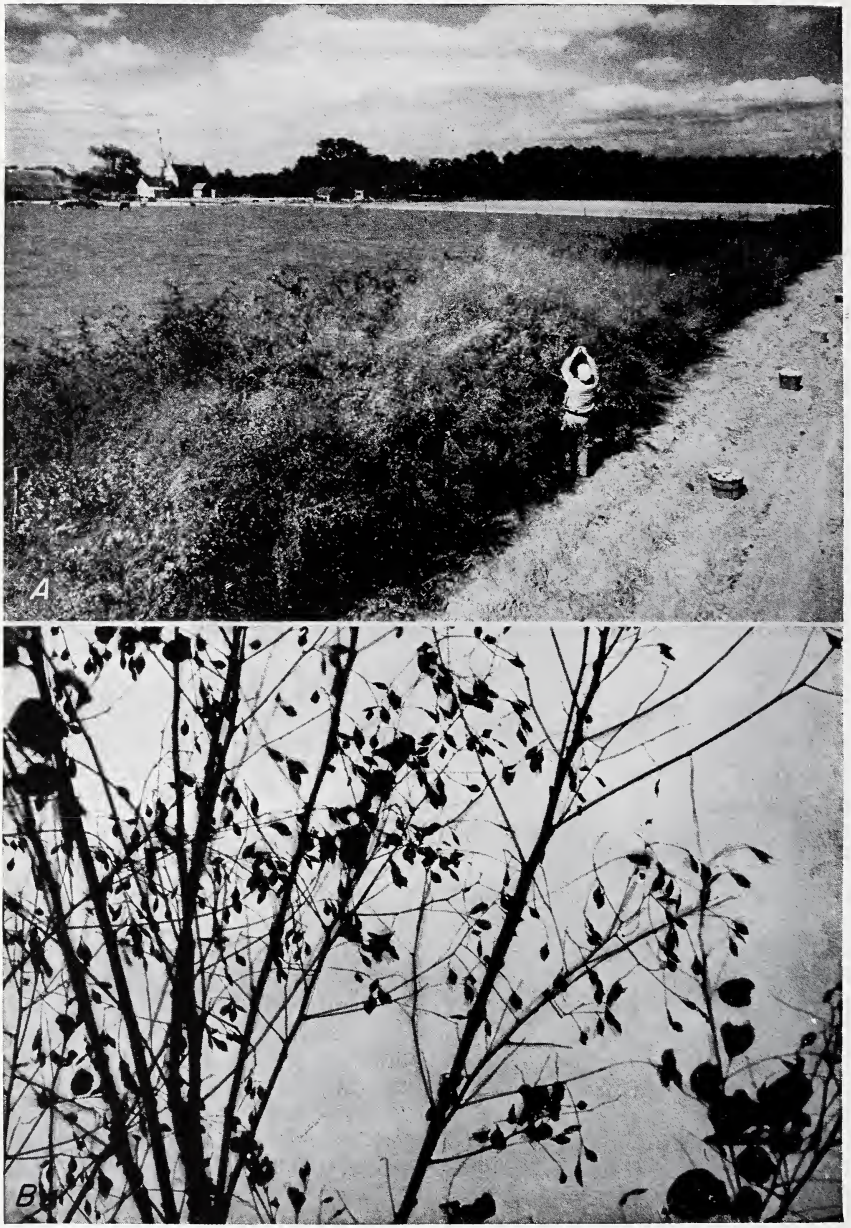

FIGURE 3.—*A*, Bicolor lespedeza in this hedge forms an attractive line of lavender-flowered shrubs from July to October. It provides a safe travel way for wildlife across open fields, connecting other permanent coverts at the sides. Combining the bicolor with a row of multiflora rose on the pasture side adds to the protection. *B*, Bicolor usually produces an abundance of seed pods.

ful—one in a poor sandy area of southern Delaware; the other, in western Pennsylvania, in an area which had been damaged by a field fire. All other plantings had good survival and fair to good growth, the average height growth being about 3 feet in 3 years. On the coastal plain of the eastern shore of Maryland, however, this was exceeded by a planting from direct seeding which grew 9 feet in 4 years.

The plants generally matured in 4 to 6 years.

Autumn olive does not require soil of high fertility and seems to be adapted to soils of all textures. Northern and central New England, the highlands of New York and West Virginia, sandy coastal plains, and the Piedmont all seem to have suitable soils. No observations of the tolerance of the plant to wet soils have been made.

Although the plant needs further study it can be recommended now for use in shrub borders and in odd-area plantings in the rows nearest the trees. One-year-old seedlings spaced 4 to 6 feet apart are recommended. Direct seeding also shows promise.

Bicolor lespedeza (*Lespedeza bicolor*)

Bicolor lespedeza, commonly referred to merely as "bicolor," is one of at least 19 species of shrub lespedezas, all native to the Orient. It is an upright, leguminous shrub growing to a height of 9 to 12 feet. The young stems are light brown and somewhat grooved; the old branches are dark brown and rather smooth with lighter colored raised pores. The leaves are trifoliate, similar in some respects to those of red clover. The leaflets are oval-shaped and about 1 to 2 inches long, dark green above and lighter green below. The flowers, which appear from late July until frost, are rosy purple and arise from rather long stalks in axillary racemes. The seed pod is broadly oval, about ¼ inch long, and has a beaked tip. It is unjointed and carries a single seed. The seeds are dark purplish brown, becoming mottled brown when fully ripe. They hang on the plant through autumn, dropping off gradually. Some plants hold a considerable amount of seed well into the winter (fig. 3).

Bicolor is easily established by either planting or seeding. Growth is rapid on fair to good sites and usually is satisfactory even on poor sites. The plant matures seed in about 3 years, occasionally in 2, or even in 1 year under optimum conditions. Reproduction is by seed only. The plant does not spread in the face of appreciable plant competition.

Survival, growth, and rate of establishment vary somewhat, depending on whether seed or planting stock is used. Plantings made from seedlings in Delaware, Maryland, West Virginia, New Jersey, Pennsylvania, Massachusetts, and Connecticut generally had good or excellent survival. A few plantings in New York and Vermont had high winter losses.

On good sites the young plants grew 6 to 9 feet in from 3 to 5 years and reached mature heights of 9 to 12 feet in 5 to 8 years. On poor sites the height was from 3 to 6 feet in 5 years and mature height of 9 feet in 8 years. Except in Vermont and up-State New York, the plantings reproduced by seed beginning usually with the third or fourth year. Plants have produced mature seed and young seedlings have succeeded

in establishing themselves even when grown on gravel banks as in a northern Connecticut planting.

Direct seeding has given good results as far north as southern Pennsylvania, northern New Jersey, and the Cape Cod area in Massachusetts. The seedings were made by broadcasting about 10 pounds of cleaned seed per acre either on prepared seedbeds or on bare areas without preparation. Most stands averaged from 1 to 8 plants per square foot, although some plantings in northern Pennsylvania and New York had an average stand of only 1 plant per 10 square feet. The sparse stands were unsatisfactory since they failed to have at least one plant per square foot, rather evenly distributed—the minimum considered necessary for success. The growth rate of seeded plantings varied with differences in site preparation, fertility, weather conditions, and time of seeding. Early seeding is highly desirable, as late spring seeding either delays germination a year or retards the start of growth to such an extent that little growth is made the first season.

The growing season in 1945 was unusually favorable. Maryland seedings made in March and early April of that year produced plants averaging 18 inches in height by fall, some plants reaching 6 feet and maturing seed the first year. First-year growth in normal years was about 6 to 10 inches. In the second year, stands averaged about 3 feet; and third-year heights were 5 to 7 feet.

Site domination has been attained more consistently by seedings than by seedling plantings. Inability of the seedling plantings to dominate the site was due partly to the wide spacing—usually 6 feet—which gave other plants a chance to occupy the open spaces. Better results with seedlings should be obtained if the spacing between plants is not more than 3 feet. When a good seedbed can be prepared, direct seeding is the easier method of establishment, though less certain of success than when seedlings are used.

Shrub lespedeza is suited to sites with difficult erosion and revegetation problems, such as the spoil banks of large drainage ditches, the "monkey mountain" spoil banks resulting from soft-coal strip-mining in western Pennsylvania and West Virginia, and the sterile sands of the New Jersey "barrens" (fig. 4). Both seeding and planting have produced good stands on such areas. This shrub is apparently adapted to a wide variety of soil conditions, only wet soils and very acid ones appearing to be unsuited to it.

Plants vary somewhat in hardiness. Throughout the Northeast the branch tips of some plants may die back each year. Within a single planting there may be varying degrees of "winter-kill," with the result that some plants may have no winter damage whereas others may die all the way to the ground. No serious loss of roots caused by winter freezing has been noted except in upper New York and Vermont. Winter "die-back" of individual plants here and there is not a serious matter as the injured stems grow back naturally each season and the ability of the plant to mature seed does not seem to be greatly affected.

Ordinary bicolor lespedeza flowers late in the summer and normally does not mature seed until about the second week of October. It is therefore apt to be injured by killing frosts before the seed has hardened. As a result, dependable seed production of the common strain is limited to the area from southern Pennsylvania and New Jersey southward.

Bicolor seed has proved to be such an outstanding food for bobwhite

FIGURE 4.—Bicolor lines the tops of the raw spoil banks on each side of the drainage channel next to the trees. The opening through the woods for the channel and the bicolor cover help to increase wildlife populations.

quail and pheasants that the development of varieties which will provide dependable seed crops is a matter of considerable importance. An early maturing type of bicolor or other equally good shrub lespedeza that would produce dependable seed crops has therefore long been sought for use in the natural quail range and in the northern part of the pheasant range.

Throughout the Eastern States, particularly the Northeast, seeds have been collected from plants which produce seed well ahead of the normal dates. Seedlings produced from the seed of such plants have been tested out in new field plantings to determine how well the desired characteristic is passed down. Seeds from the best of these plants are in turn collected and the process repeated. By plant selection and testing, strains have been developed that seed 2 to 3 weeks ahead of average dates and appear to be suitable for use as far north as Massachusetts. One such variety seems to transmit its desirable attributes consistently enough that steps are being taken to give the plant a distinctive name and separate botanical description.

The development of superior varieties of bicolor, after satisfactory seeding types have been found, involves the selection of plants that produce heavy yields and retain their seed on the bushes through the winter. Long seed retention is especially important in heavy snow country where the only seeds available for wildlife in the winter are those which stay on the plants well above ground level.

Bicolor, like many other legumes, is highly palatable to domestic animals. Plantings just outside pasture fences are usually grazed as far as animals can reach, and livestock even attempt to break down fences in order to reach the shrub notwithstanding the presence of other good forage within the pasture. All plantings, accordingly, must be well protected against destruction by livestock.

Bicolor is especially well suited for use in hedge plantings and in borders between crops and woods (fig. 5). Since seedbeds in such places can be prepared by methods ordinarily used in regular farming operations, plantings can be easily established.

Bicolor is useful for developing wildlife areas on land unsuited to crops.

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FIGURE 5.—Pine woods and crop fields separated by a 3-year-old seeded bicolor border. Good crops grow to the edge of the field, good trees in the woodland. Bobwhites find good cover and excellent food in the border.

Barren areas can either be seeded or planted, but where plant competition is heavy and a seedbed cannot be prepared, seedlings should be used. The plant spacing in seedling plantings should be from 3 to 4 feet.

For seeded plantings the rate of seeding is 10 pounds per acre if the seed is to be broadcast and 5 pounds if sown with a drill. Seedbeds at field edges are prepared in the same manner as for grain seeding. Fertilization is advisable but not always essential. Lime is needed only on very acid soils that have a pH of less than 5.0. Seeding should be done as early in the spring as possible—February, March, or early April. The seed should be scarified before planting and raked in lightly after sowing. Use of lespedeza inoculant is necessary if there are no lespedezas, cowpeas, crotalaria, beggarweeds, kudzu, lima bean, or partridge pea in the vicinity. Inoculation is rarely necessary, however, in areas south of New York.

Very erodible sites should be protected by a light mulch cover of straw, hay, manure, or evergreen boughs to prevent washing of the soil until the young plants have become established.

Bicolor furnishes both cover and food for wildlife. It provides a good type of shrub shelter for both birds and mammals during the growing season, and even in winter after the leaves have fallen the open stands with their deep ground litter are frequented by the cottontail rabbit and other mammals. The seeds are a first-quality food for bobwhite quail, and pheasants not only readily eat the seeds but maintain their weight as well on this diet as on scratch grain. Cottontail rabbits find both the bark and foliage very acceptable food. Deer browse the foliage, sometimes causing great damage to the plants.

Bicolor has several other values. It is a desirable honey plant, flowering in the last half of summer when good honey plants are both needed and scarce. The amber-colored honey is of fine quality. Besides being a good erosion-control plant, it is a leguminous soil-improver. The ornamental quality of its floral display enhances the beauty of the land-

scape; woodlands framed in flowering lespedeza are a delightful scene in August and September.

Although bicolor is now considered the best of the shrub lespedezas for conservation purposes, continued testing may show others to be equal or superior or to have special qualities. Several of these are discussed in succeeding sections of this circular.

Tatarian honeysuckle (*Lonicera tatarica*)

This upright bush-honeysuckle, originally a southern Russia and Turkestan plant, has long been used for ornamental planting in this country. Many horticultural varieties of the plant have been developed for decorative purposes.

Its mature height ranges from 6 to 12 feet, depending upon the soil and growing conditions. The leaves are simple, opposite, oval-shaped, from 1½ to 3 inches long, short-stemmed, and pointed at the tip. The plant blooms profusely in May and June with pink to white flowers ¾ to 1 inch long. The fruit, about the size and shape of a pea and bright translucent red or occasionally yellow, matures in July and August. Many of the fruits remain on the plants until fall.

The shrub has an erect form. The roots send out numerous stems which form a thick base and the foliage and branching are fairly dense.

Tatarian honeysuckle is a hardy plant that can be used anywhere in the Northeastern States. It is easily established by planting 1- or 2-year-old seedlings. Although the base of the plant thickens rather early with short stolons, the shrub is not aggressive and presents no danger of spreading to places where it is not wanted.

Of 23 plantings 5 to 12 years old in Maine, Vermont, Massachusetts, New York, New Jersey, Pennsylvania, Maryland, and West Virginia, 21 had good or excellent survival. (One of the poor plantings, located near Oxford, N. Y., had been smothered by a rank growth of grass; the other, near Attica, N. Y., had been planted in raw, infertile soil on a very dry area.)

The success of these plantings, nearly all of which were on gullied areas, road banks, and other unfavorable sites, demonstrated the plant's ability to survive under adverse conditions. However, its extremely slow growth on very poor sites limits its usefulness for erosion control. Some plantings at the end of 7 years averaged only about 4 feet in height, and two plantings made still less growth. Those on fair sites did much better, making up to 8 feet of growth in 7 or 8 years and reaching mature height of 10 feet within 10 to 12 years. Such stands were about 2 or 3 feet high at the end of 3 years, and 5 to 6 feet high in 5 years. Many of the plants grew slowly until about the fifth year and then made rapid height growth.

Among the desirable features of these plantings was the good form and vigor of the plants. Even where growth was slow in the first few years, the plants were much branched and well balanced. This was true not only on good sites but on very poor areas where plants of nearly all other species, if they survive, develop only a straggly form.

Several plantings of Tatarian honeysuckle accessible to cattle withstood browsing better than any other shrub except multiflora rose. Whereas plants of almost all other shrub species were destroyed by the animals, these not only survived but kept their form very well. Unlike

the rose, however, Tatarian honeysuckle does not form a living fence against cattle.

Honeysuckle has done well in mixed black locust and honeysuckle plantings despite shading by the locust. This tolerance makes the shrub useful for planting on sites subject to partial shade.

Plantations generally begin to mature fruit in the third or fourth year, or when the bushes reach a height of about 4 feet. Heavy fruiting begins after the plants reach 5 to 6 feet, or in about 5 or 6 years. Grazed or heavily shaded plantations produce little fruit.

Whereas the early plantings were made mainly for the purpose of controlling erosion in gullies and on other very severely eroded areas, the use of Tatarian honeysuckle in recent years has been extended to better sites in the form of wildlife borders, windbreaks, and hedges (fig. 6). Growth is more rapid on such sites provided the planting is well done. In borders and wildlife area plantings, the shrub should be planted in about the third or fourth row from the open field behind lower growing varieties. Spacing in the row and between rows should not exceed 4 feet. In hedges, the spacing should be 1 to 2 feet. In windbreaks, where it is used generally on the windward side of trees, the plants may be spaced about 3 feet apart.

Tatarian honeysuckle is suited for use on a wide variety of soils—dry, well drained, or poorly drained; acid or alkaline; poor or fertile—but the driest and poorest areas and extremely wet upland areas should be avoided. When the plant is used in hedges or windbreaks, the planting site should be plowed or at least furrowed. If the planting site is sodded and plowing or furrowing is impracticable, at least a square foot of ground should be scalped for each plant and all competing sod removed. Planting should be done by the center-hole method.

This shrub develops a good type of wildlife shelter, especially for shrub-nesting birds. The hedges and windbreaks provide excellent travel

FIGURE 6.—Tatarian honeysuckle in a windbreak helps to protect fields from damaging winds. In open fields where there is little other cover it provides an island of refuge for wildlife.

lanes and the fruits furnish summer and early fall food for many songbirds. The flowers are attractive to honeybees, and both flowers and fruits have considerable ornamental value.

Bayberry (*Myrica carolinensis*)

The bayberry is a small native shrub found from New Brunswick to Florida, mainly along the coast; also in scattered areas of sandy soils in western New York and Pennsylvania.

It is an upright plant, growing as high as 5 to 7 feet except in areas north of Massachusetts. The leaves tend to hang on the twigs through the winter in a semigreen state, although this character varies greatly. They are alternate, narrow, oblong, rather glossy dark green, and from 1 to 2½ inches long. They have a pleasant aromatic odor, especially when crushed. The shrub flowers inconspicuously in the early spring. A few plants may bear both male and female flowers but on nearly all plants the flowers are all of one sex. The fruits ripen about October and remain on the plant all winter. They are grayish white in color, arise in small clusters on very short branches along the main stems, and are from ⅛ to 3/16 inch in diameter. They have a highly scented, waxy coating.

Bayberry is easily established by planting 2-year-old nursery-grown seedlings. The plants mature in 4 to 5 years. Reproduction is both by seed and stolons. Because of the inability of the plant to stolon rapidly it does not spread into sod or farmed areas except in poorly managed pastures along the New England seacoast where growing conditions are ideal.

Since this plant is found naturally only on sandy areas, almost always close to large bodies of water, one would expect it to be of limited suitability for planting. On the contrary, the success of plantations in clay as well as sandy soils in areas from Vermont to West Virginia demonstrates that it is well adapted to a variety of soil and climatic conditions. Only limestone soils have proved unsuited.

Measurements were made of 42 plantings from 5 to 12 years old in Vermont, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, and West Virginia. Many of the plantings were in gullies with poor growing conditions, some in borders at the edge of tree plantations, a few in hedges. Survival was excellent in 9 of these plantings, good in 19 others. Only 5 were failures, the poor results being due to planting in alkaline soil or on an active sand blow, or to poor planting and possibly poor stock. The best and quickest results have been obtained on good sites.

Bayberry plantings generally are slow to start growth, the poorer ones growing only 12 to 15 inches high in the first 3 years, the better ones 18 to 24 inches. By the fifth year, the majority are 2½ to 3 feet high, the better ones 3½ to 4 feet. Plantings begin to fruit when they are about 5 years old. Some reach full height of 5 to 7 feet in 6 or 7 years; others take an extra year or two. A 7-year-old contour hedge near Johnstown, Pa., which dominated its planting site, averaged 5 feet in height. Four- to six-inch stock was used in most of these plantings. Both growth and survival would be improved by using 2-year-old planting stock 9 to 12 inches high.

In all of the successful plantings the plants had excellent form and vigor.

Bayberry resists browsing by domestic livestock and deer very well, producing a fair cover if grazing is not concentrated. The main damage to unprotected plantings results from trampling.

Bayberry is recommended for use in hedges, windbreaks, wildlife borders, and other wildlife plantings (fig. 7). In hedges, the plants should be spaced 1 foot apart in a single row, or 2 feet apart for staggered spacing in 2 rows. For other uses, the plants should be spaced 3 feet apart. In borders, bayberry should be planted in the outer row or two next to the open field. It can be used on any soil from dry to poorly drained, poor or fertile. It should not be planted in soils high in lime.

Bayberry is a good erosion-control shrub. The thick, enduring mulch of leaves built up on the ground beneath the plants greatly increases its effectiveness for this purpose.

It is one of the best shrubs for improving cover and food conditions for farm wildlife. It provides shelter for game and small birds during the plant-growing season, and the tendency of some leaves to remain on the plant throughout the winter helps to give it a year-round protection value. Probably its best wildlife benefits come from the fruit crop which it regularly produces (fig. 8). The fruit is a staple food of the bobwhite quail and ruffed grouse and is readily eaten also by the ring-necked pheasant, wild turkey, and at least 35 kinds of songbirds. The fact that the fruits are available above the snow all winter makes the plant especially useful for wildlife in the Northern States.

FIGURE 7.—Bayberry in this curving hedge marks the division between strips in a field strip cropped on the contour. This subevergreen shrub not only aids in controlling erosion but is pleasing to the eye.

FIGURE 8.—The waxy fruit of the bayberry provides food for quail and songbirds.

Bayberry has other qualities that are esthetic and at the same time practically useful. The fruits, because of their waxy covering, are used in making bayberry candles, and the production of this popular Christmas article has developed into a good-sized industry in the Cape Cod area of Massachusetts. The fruited branches, bare of leaves, make

attractive decorative materials for indoor use in fall and winter, and the berry-laden branches find ready sale at roadside markets along the coastal roads during the autumn. Bayberry plantings on the farm, even when made primarily for utilitarian purposes, lend a touch of beauty to the landscape.

Multiflora rose (*Rosa multiflora*)

Multiflora rose, a plant introduced from Japan nearly a century ago, is one of the best shrubs for erosion control, wildlife cover, and farm-conservation use. Polyantha roses and other popular, present-day, cultivated roses are derived from it. It is used by rose growers as the hardy understock for the budding of fancy tea roses. It is a vigorous shrub that normally reaches a height of 6 to 10 feet, and to even greater heights if the upper branches have access to adjacent tree limbs for support. However, it is not a true climber since it lacks the clinging tendrils and the entwining habit of vines. The branches grow in a long arching sweep so that single plants may be about 8 feet wide.

The leaflets are usually nine on each main leaf stalk, oblong in shape, about ½ to 1½ inches long, and finely toothed. The small white flowers develop in numerous clusters in late May and June. The fruits are red, pea-size, and remain on the bushes throughout the winter. Some varieties have stiff thorns and the intertwined branches of such plants when close-grown make tight fences. The thornless varieties are not recommended for conservation plantings or living fences.

Multiflora rose reproduces both by seed and by layering of branch tips. It does not spread by root runners or stolons. The seed is spread to some extent by birds. Since the tips of drooping side branches which come into contact with bare ground readily take root if not disturbed, and the seeds are able to germinate in bare earth, the plant is highly useful in controlling erosion on bare eroding areas. Conversely, seeds or branch tips can rarely germinate or take root in sod or among other plants, nor can young shoots survive the competition of other plants. These traits, combined with the use of ordinary good mowing, pasture management, plowing, and grazing practices help to keep multiflora rose from spreading.

Although multiflora rose has been known to escape from abandoned lands and develop into thickets or stands of scattered plants, usually in combination with other woody and herbaceous plants, such invasions have generally involved the thornless variety used for rose budding. This variety seems to reproduce in grass more vigorously than the thorny, upright type recommended for conservation plantings. However, even escapes which occurred decades ago have not resulted in the invasion of farmed fields. On the contrary, most very old plantings have remained in place for dozens of years without spreading.

Multiflora rose was first used in conservation plantings in the Northeast in 1938. Its possibilities as a living fence soon became apparent in both the Midwest and Northeast. As a result, its use increased rapidly and in the Northeast it is now used more than any other shrub in conservation plantings.

Fifty-seven conservation plantings 3 to 12 years old and a number of

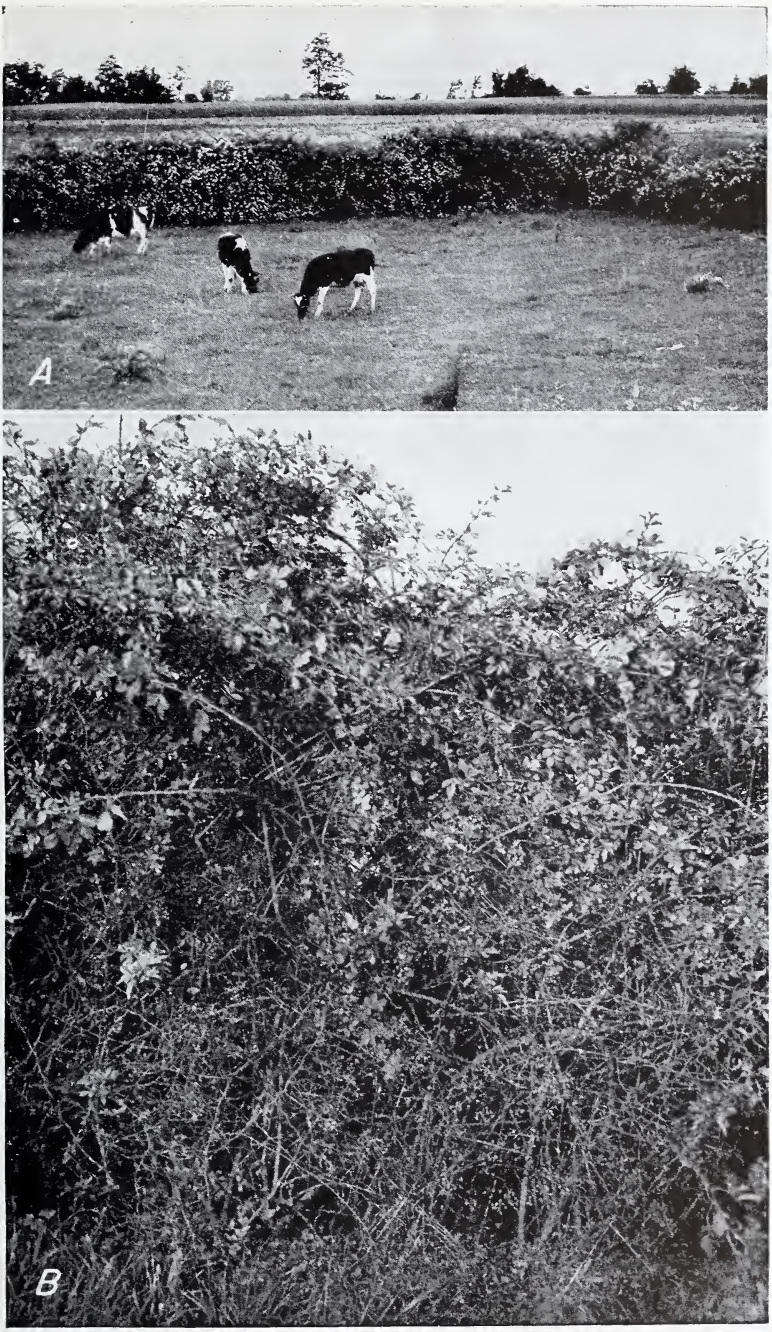

FIGURE 9.—*A*, This 9-year-old hedge of multiflora rose on the contour was easily established and provides a permanent pasture fence requiring very little maintenance; *B*, the dense, thorny tangle of branches effectively bars the passage of livestock.

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older ornamental plantings have been measured or observed to determine the behavior and value of the plant for conservation purposes.

Five plantings made on Piedmont soils in northern Delaware in 1938 had uniformly excellent survival, although the raw gullies and field borders chosen for the plantings were not particularly good sites. Stem growth was 4½ feet in the first 3 years. Additional growth of a foot each year for 2 more years resulted in an average growth of more than 6 feet by the end of the fifth year. The 12-year total growth was about 8 feet.

Because the taller canes are always arched, the plant height is somewhat less than the stem length. Nearly all of the height growth is made in the first 5 years. As the height growth slows down, the number of branches and basal canes increases and greatly adds to the density of the plants. The rose plantations attained site dominance in borders and gullies in 5 years.

Black locust, when planted with multiflora rose, forms an upper story which shades the rose, causing the canes of the lower growing rose to greatly increase their lateral growth in an effort to obtain light. In a gully planting of this type the canes grew an average of about 9 feet in 5 years. Profuse layering of the stems subsequently made it so difficult to identify the original plants that growth in later years could not be determined. Shading by the locust made about a 50-percent canopy and greatly reduced the flowering and fruiting of the rose.

Plantings in Maryland have had equally good results in coastal-plain, piedmont, and limestone areas. A hedge fence on coastal plain soil near Chestertown grew 61 inches in 4 years and had good survival. Full height of 8 feet was attained in 6 years (fig. 9). Another planting in the same area had excellent survival and grew 6 feet in 5 years. These hedges were planted originally with only about one-fourth the number of plants now considered necessary for the early formation of an unbroken livestock fence. The plants were widely spaced at intervals of 4 feet. Despite the small quantity of plants used and the wide spacing, the hedges now form almost complete barriers to the passage of livestock.

A hedge-fence in Worcester County, Md., also on the coastal plain, which had been planted half inside a pasture and half outside, exemplifies the behavior of this shrub under grazing conditions. In 2 years the growth of the protected outside part averaged 70 inches as compared with 54 inches in the pasture part, but both sections had an effective height of 3 feet in two seasons and were 8 feet high in 4 years. The grazed plants were denser due to browsing of the branch tips. Another pasture-fence planting at the edge of a mine-spoil area in Clarion County, Pa., gave similar results. Average growth in 2 years was 5 feet where the plants were protected and only a little less on the pasture side. The hedge was 8 feet high in 6 years. The survival rate, although only good, was highly satisfactory in view of the difficulty of revegetating the poor soil usually found in mine-refuse piles.

Other plantings in Pennsylvania and plantings in West Virginia have given as good or better stands, the more recent ones growing to effective fencing height faster because of better planting methods. Plowing the planting site results in speeding up the growth so that an effective fence can be grown in 4 years instead of 6. It is believed that by fertilizing and cultivating the first season, the time required to develop a fence which would turn livestock could be shortened to 3 years.

FIGURE 10.—Multiflora rose in a wildlife border protects the woodland from both grazing animals and property trespassers.

Plantings are succeeding well on a great variety of soil types in Lancaster, Bucks, Lebanon, York, Fulton, and Clarion Counties in Pennsylvania, and in Marshall, Barbour, Mason, and Greenbrier Counties in West Virginia. Survival has been uniformly satisfactory; growth was 3 feet in 2 years, 6 feet in 4 years; and full height was reached in 5 or 6 years.

The average height growth of most of the early plantings in New York was somewhat poorer than in most areas—about 5 feet at the end of 5 to 7 years. Survival, though good, was also less than in plantings elsewhere. The slower growth was attributed mainly to the severe plant competition resulting from failure to remove a sufficient amount of sod in planting. Subsequent observations confirm the fact that plant competition and not adverse climate is chiefly responsible for the slowing up of the growth and even the death of multiflora rose plantings, and that if the rose is kept free from such competition during the first 2 years it will then take care of itself. Numerous later plantings from New York to Maine confirm the importance of careful initial planting as the key to success.

Recent plantings have been established as rapidly at low and medium elevations in New York as in places farther south. Exceptionally good culture is essential for plantings on poorly drained soils at elevations above 1,500 feet.

A gravel-pit planting in northern Connecticut grew to a height of 60 inches in 6 years. Another of the same age at an elevation of 1,100 feet in northern Vermont averaged 61 inches with some plants 90 inches high. Although deep snows offered a measure of protection in the Vermont planting, the degree of winter damage sustained by the branch tips indi-

cated the possibility of serious injury by freezing in very cold winters. A sand-blow planting at a lower altitude in Vermont (near Burlington) attained a thriving 81 inches in 6 years. A hedge adjacent to a road near Belfast, Maine, grew to a height of 5 feet in 3 years in spite of side damage caused by snow piled on the plants through road clearance.

It is evident from these examples that growth is slower in the northern areas and that the precise northern limit for effective use of multiflora rose is still rather indefinite. However, the plant seems to be adapted to the soils and climate of all parts of the Northeast with the possible exception of the Adirondack, Green, and White Mountain areas, and northern Maine.

Although the most outstanding and significant step in the development of multiflora rose as a conservation plant is its growing use as a hedge-fence for pastures, the plant is potentially useful in many other kinds of shrub plantings. Increased opportunities to give similar natural-fence protection to farm ponds, streambanks, large gullies and other badly eroded areas within pastures, and to woodlands, will undoubtedly result in extending its use on a much larger scale (fig. 10). As a regular component of plantings in borders and in wildlife areas, it is unsurpassed for furnishing protection for wildlife, including a means of escape from natural enemies. It is one of the best shrubs for controlling erosion on road banks and along public highways, and it does well on sand blows and on spoil banks of soft-coal strip mines.

As previously noted, the secret of success is freeing the rose from the encroachment by other plants during its early life. A clean plant bed should therefore be prepared if multiflora rose is to be planted in hedges, windbreaks, field borders, above streambanks, and, in fact, in any location where machinery can be used to advantage. The plowed or disked area should be at least a double-plow furrow in width and correspondingly wider for plantings more than one row wide. On sodded areas which cannot be plowed, at least one full square foot of sod should be removed for each plant.

Plants for hedges, hedge fences, and other protective plantings should be spaced not more than 2 feet apart, preferably only 1 foot. For other purposes wider spacings may be used—2 to 3 feet for roadbanks, 3 to 4 feet for regular borders and wildlife areas. One-year-old nursery-grown seedlings are quite satisfactory but two-year-olds may be used if the seedlings are top-pruned when planted. Direct seeding has given promising results but further study and testing is needed before this method can be definitely recommended for general use.

Rapid growth of plants is especially important in hedge-fence plantings. Such plantings, therefore, should be fertilized at planting time with a complete fertilizer such as 5–10–5, and either cultivated once or twice a season for the first 2 years or mulched with manure, sawdust, wood chips, or straw. Since fertilization also encourages weed growth, the plantings should not be fertilized unless they will also be cultivated or mulched. The fertilizer should be applied at the rate of 1 pound for every 40 feet of row. A side dressing the second year of 1 pound of nitrate of soda, or equivalent, for every 40 feet improves growth.

Multiflora rose is suited to planting on all soils except those which are very poorly drained. It is a first-rate wildlife cover plant. It furnishes excellent escape cover against predators and is second only to the ever-

greens in providing winter protection from the elements. The fruits, which remain on the bushes above the snow and thus are available for food throughout the winter, provide good food for pheasants and many other birds.

The greatest practical use of multiflora rose probably will be as living fences requiring little in labor and cash outlay to establish and maintain. It is the best plant to use for keeping livestock out of many areas where the land must be protected from grazing animals in order to control erosion. It can be established in pastures while they are being grazed if a good initial planting job is done. It compares well with other shrubs used for direct erosion control and is better for this purpose than most shrubs that provide a similar type of cover.

Its ornamental value is high (fig. 11). The individual flowers, though small, occur in dense clusters, and during the late spring the long rows of conservation plantings present a beautiful floral display. The clusters of bright red berries are equally attractive. They retain their color and beautify the landscape throughout fall and winter. The fruiting branches, like those of bittersweet, may be cut for indoor decorative use.

FIGURE 11.—The attractive flower clusters of multiflora rose give this plant a high ornamental value.

Most plantings, once established, require little if any further culture. Although hedge fences may occasionally lose plants, replacements are provided through the layering of branches of neighboring plants. In the meanwhile, the dead canes help keep the fence livestock proof. Pruning is needed only if it is desired to confine the hedge to a narrower strip than that normally occupied by the plants.

This rose, like others, is subject to damage from the Japanese beetle

and other insects. Diseases such as leaf spot and crown gall also affect it. However, it is more resistant to damage from pests than most other roses and no serious injuries due to these causes have been experienced.

Purple-osier willow (*Salix purpurea*)

This shrub willow, sometimes called basket willow, grows to a height of 10 to 18 feet. It has smooth, slender, tough, resilient branches, somewhat purplish at first but later changing to gray or olive gray. The leaves are smooth, tongue-shaped, finely toothed near the tip, 2 to 4 inches long, bluish green above and pale below. Although arising in pairs, they are not exactly opposite. The catkins are small, in nearly opposite pairs, and mature in the spring before the leaves come out.

This willow is a thicket-forming shrub with many-branched roots, spreading by stolons and layering of branches. It has been used successfully in conservation plantings only on streambanks where it has proved to be better than other shrubs for protecting the middle and upper parts of the banks against erosion. Only the red-osier dogwood, when used in plantings at the bottom of the bank along the water line, compares with it favorably.

Ten farm plantings on the banks of the Winooski River in northern Vermont, made in 1938, have been observed during a 12-year period. Height growth of the willow in these plantings averaged 9 feet in 12 years, most of which was made in the first 4 or 5 years. The poorest of the streambank plantings averaged 6 feet, the best 12 feet. In damp spots

Figure 12.—Purple-osier willow mats down and protects riverbanks from damage by floods and ice. When the tons of ice melt, the willows spring back or send up new stems able to resist future floods.

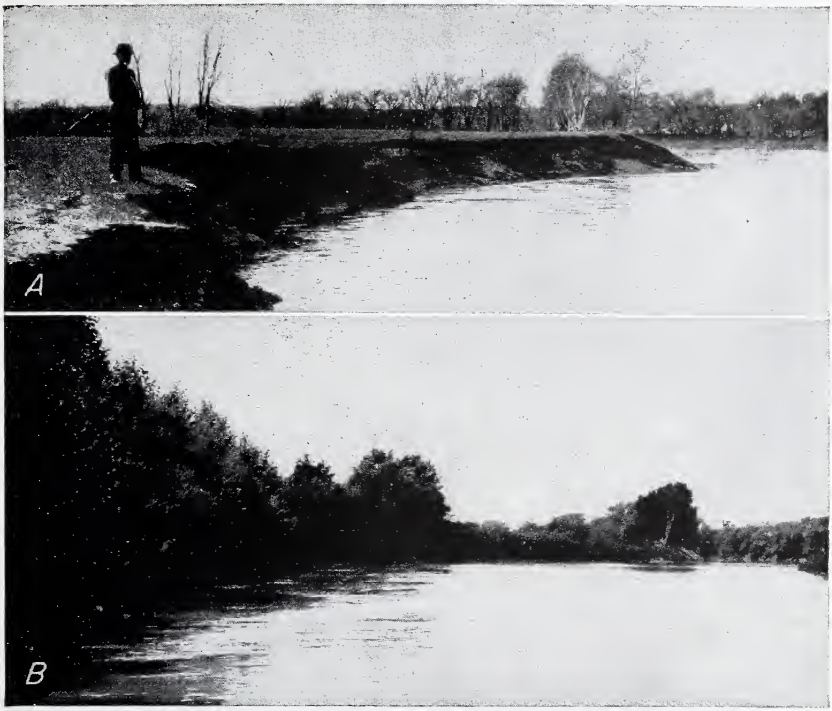

FIGURE 13.—*A*, This raw eroding streambank has helped to muddy the river and load it with silt. Each year this farmer lost part of his best field. Fishing became a little poorer. *B*, The same bank covered with purple-osier willow. The blanket of shrubs keeps floods from robbing the farm of its soil. Less mud in the stream means better fishing, and wildlife has a new home close to water.

not subject to severe water and ice damage, growth reached 15 to 18 feet.

The plantings generally had good survival. They developed an excellent erosion-control cover on streambanks except (1), in spots lacking stone riprap or other structures adequate to protect the planted bank against undercutting; or (2), where attempts had been made to plant raw cuttings through a brush-matting mulch which had been applied and wired down prior to planting.

Eight streambank plantings in New York and Pennsylvania, which were measured and observed for 3 to 10 years, had survivals ranging from fair to good, the low survivals occurring in small test plots in which grass competition was exceptionally severe. Height growth in the better plantings reached 6 to 8 feet in 4 to 6 years. Two stands were cut back by beavers.

The superiority of purple-osier willow for streambank-erosion control is due to its resilience, ability to layer new plants, and tendency to recover quickly from mechanical damage, all of which makes it well adapted to withstand battering by water and ice (fig. 12). Plantings on the Winooski River often look like skeletons after the spring freshets and ice break-up have stripped the plants of their bark and branches. Recovery is surprisingly rapid and the new growth is usually denser than the old (fig. 13).

Purple-osier willow is recommended for use only on streambanks. Either rooted cuttings or fresh green-wood cuttings can be used, but rooted stock is more desirable when the cuttings are to be planted in dug holes. Fresh cuttings should be 3/8 to 1/2 inch thick at the butt end and 12 to 15 inches long, and should be planted, if possible, within 1 day after they have been cut. Planting is preferably done in early spring before the leaves come out, but may be done at other times of the year if the planting stock is carefully handled and properly planted. Fresh cuttings should be planted vertically, with not more than an inch of stem protruding above the surface of the ground. Dibbles or planting bars used for making holes should be only a little larger than the cuttings. The soil must be tamped firmly against all cuttings to eliminate air pockets. Where the soil is damp but too stony for this sort of planting, the cuttings may be buried horizontally 2 inches or more below the surface, the depth depending on the compactness of the soil.

Purple-osier willow is sometimes attacked by a canker disease which causes the stems to die back. The resulting injury is not serious.

SHRUBS RECOMMENDED FOR LIMITED OR SPECIAL USE

In addition to the 7 species of shrubs recommended for general use in the Northeast, there are 16 others which may be endorsed for limited use or for certain special purposes. (In this class, the four shrub lespedezas, the two privets, and the true and hybrid filberts are respectively grouped as single "species" for convenience in discussion). Some of the plants in this class are too limited in soil adaptability for general use or are too expensive to grow in the nursery for quantity production. Others are well adapted only for special uses such as game plantings or cover on road banks or mine spoils, and are not particularly valuable for other purposes.

The 16 limited-use species or species-groups are:

Celastrus scandens	American bittersweet	
Cornus racemosa	Gray dogwood	
Cornus stolonifera	Red-osier dogwood	
Corylus americana	American	Filberts
C. americana × *avellana*	Hybrid	Filberts
Lespedeza cyrtobotrya	Cyrto	Shrub lespedezas
L. japonica intermedia	Japan	Shrub lespedezas
L. robusta	Robust	Shrub lespedezas
L. thunbergi	Thunberg	Shrub lespedezas
Ligustrum amurense	Amur	Privets
L. ovalifolium	California	Privets
Lonicera japonica halliana	Halls honeysuckle	
Lonicera maacki	Amur honeysuckle	
Prunus besseyi	Bessey sand cherry	
Rosa rugosa	Rugosa rose	
Rosa wichuriana	Wichura rose	
Symphoricarpos orbiculatus	Coralberry	
Viburnum dentatum	Arrowwood viburnum	
Viburnum lentago	Nannyberry viburnum	
Viburnum prunifolium	Blackhaw viburnum	
Viburnum trilobum	American cranberrybush viburnum	

American bittersweet (*Celastrus scandens*)

American bittersweet is a native vine occurring naturally in areas ranging from Maine to Manitoba and south to New Mexico and Florida. It twines about trees or poles and may reach a height of 20 feet or more, but generally grows closer to the ground. Its unique yellow-capsuled fruits open in three parts on ripening, exposing the crimson, fleshy pulp covering the seeds. The clusters of bright red and yellow fruit remain on the plants throughout the fall and winter, retaining their bright colors long after the branches have been cut.

On the whole, bittersweet plantings made as far back as 1937 in areas ranging from Vermont to Delaware and West Virginia have been moderately successful. However, the climbing and twining habit of this plant prevents it from developing the height and form needed to fill its proper space in a border, hedge, or similar type of planting. Its conservation value depends mainly on its use as a desirable "fill-in" species for plantings made up primarily of other kinds of shrubs.

Of 19 plantings ranging in age from 6 to 12 years, 14 had excellent or good survival. The growth rate, however, was highly variable, the average length of stems produced in 7 years in different plantings ranging from 15 inches to 12 feet. Stem growth on the whole averaged 12 to 30 inches in 3 years, 30 to 60 inches in 5 years, and about 6 feet in 7 years, with little further growth afterwards. Fruiting may begin at about the fifth year but the time of fruiting is also variable. Only 5 of 16 plantings had fruited by the time they were 7 and 8 years old.

The plants reproduce by layering and stolons, but reproduction by such means is not prolific and depends primarily on whether the plant climbs or spreads over the ground. Plantings made along wire pasture fences are invariably kept eaten back to stubs wherever they are within reach of cattle. Apart from grazing damage, the factors that limit growth seem to be poor soil and competition with other plants.

Bittersweet may be planted to advantage in borders and wildlife areas on productive soil as a "sweetening" plant that climbs over the other shrubs and adds to the cover. After the regular rows of other shrubs are planted, it may be "spotted" in here and there as an extra plant.

Two-year-old nursery-grown seedlings should be used. In planting, all competing plants should be thoroughly scalped off the ground for at least a square foot at each planting spot.

The fruiting branches of bittersweet add charm to wildlife borders. When cut in the fall they make excellent vase materials for decorative use. The fruiting branches are readily salable for this purpose.

The viney tangles formed by the plantings furnish cover for wildlife. The fruits are eaten regularly by ruffed grouse and pheasant and, to a lesser degree, by quail, rabbits, squirrels, and at least six kinds of songbirds.

Gray dogwood (*Cornus racemosa*)

Gray dogwood, a thickly branched upright shrub native from Maine to Minnesota and south to Georgia, is commonly found pioneering along field fences and in abandoned fields. It grows to a height of 4 to 8 feet, has taper-pointed oval-shaped leaves, white flowers in loose clusters, and white fruits set off conspicuously by bright red fruitstalks.

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Many plantings of gray dogwood were made in New York, Pennsylvania, New Jersey, Delaware, Maryland, and West Virginia from 1937 to 1941. Thirty-three of these growing in borders, gullies, odd areas, and on road banks have been observed and measured periodically. In general, plant survival was satisfactory, 18 plantings having excellent or good survival at the end of 5 to 13 years. Seven plantings were failures and eight had fair survival. The growth rate, plant form and site dominance were less satisfactory. In New York, a planting on muck land grew 60 inches in 8 years and had a survival of 90 percent, but the average height growth of plantings in this State at the end of 6 to 9 years was only 22 inches. The form of the plants was generally poor and in no instance had the plants dominated the site, in contrast with certain adjacent thrifty natural stands of gray dogwood which over the years had dominated their sites.

The Pennsylvania plantings were better. Height growth in 7 or 8 years average 45 inches, one planting growing to a height of 88 inches. Two Lancaster County plantings after 13 years averaged 60 inches in height and had good and excellent survival, respectively. Four had dominated their sites—three in Lancaster County, one in Indiana County. Four New Jersey plantings were failures, due partly at least to excessive wetness of the soil and grass competition. The average growth was 12 inches in 7 years. Good results were obtained in the Piedmont zone of Maryland and Delaware, although one planting that had been browsed repeatedly was reduced to stubs of about 19 inches. The other plantings, all properly protected, averaged 61 inches in 6 or 7 years. One West Virginia planting in the Ohio Valley had poor survival, and the surviving plants had poor form, failed to dominate the site, and averaged only 36 inches in height at the end of 7 years. Evidence indicates that the species may not be well adapted to coastal-plain conditions.

The successful plantings started producing fruit about the fifth year. Reproduction by stolons was noted in a third of the plants and was not prolific.

Gray dogwood has fairly high value for wildlife food and cover. It is suitable for mixed plantings in borders and wildlife areas if carefully planted in furrows or scalps. When so used, spacing should be about 3 feet. Two-year-old seedlings are recommended.

Red-osier dogwood (*Cornus stolonifera*)

Red-osier dogwood is a rather open-branched, somewhat spreading yet upright, shrub native from Newfoundland to Manitoba and southward to Nebraska and Virginia. It reaches a height of about 8 feet and tends to form thickets by stoloning. The branches, especially the new ones, are bright red. The pith is white, contrasting with the brown pith of the closely allied silky dogwood. The leaves are ovate, pointed, and 2½ to 5 inches long. The flowers are in clusters and both fruits and flowers are white.

Red-osier dogwood is found naturally only in wet places and can be planted successfully in moist and poorly drained soils, being especially well suited to the lower slopes of streambanks near the edge of the water. It has been used in plantings of various kinds from Vermont to Delaware —in Vermont on streambanks, elsewhere in borders and wildlife areas. Since it is not adapted to as wide a variety of uses or planting sites as

silky dogwood, which it closely resembles, the silky dogwood is preferable for general use. For streambank plantings, however, the red-osier dogwood remains a recommended species, and in the Northern States is probably preferable to silky dogwood for this purpose.

Of 27 plantings from 6 to 10 years of age, all but 6 had good or excellent survival. Although four of the unsatisfactory plantings were in New York, the existence of many successful plantings in this State shows that the shrub is adapted to the New York area in general. Conditions in the New Jersey coastal plain may be unsuitable for it.

Height growth in the plantings ranged from fair to good. Three streambank plantings in northern Vermont, though subject to great damage from water and ice, averaged 5 feet of growth in 6 years. Growth in 14 New York plantings from 6 to 9 years old—all in borders and gullies—averaged 42 inches. The best growth in this State was made by a gully-bottom planting near Ithaca which reached 8 feet and full site domination. Lack of success in the poor plantings, some of which failed to reach even a height of 2 feet in 6 years or more, was due to sod competition, dryness of site, or browsing by livestock. A planting of good form in northern Delaware had not only grown 5 feet but had reproduced by stolons and set fruit, indicating that the species under proper conditions may do well that far south.

The New York planting previously mentioned and a planting near Williston, Vt., reached full site dominance within the period covered by the observations, whereas 7 others closely approached this status. Some plants began to fruit in their fourth season, and even a few hardy plants at Presque Isle, Maine, made a good fruit yield. Although reproduction by stolons had begun in five plantings, including the one in Delaware, none of the plants were particularly aggressive in this respect.

For streambank plantings in New York and northern New England, red-osier dogwood should be planted with about a 2-foot spacing. One- or two-year-old nursery seedlings are preferred, but raw, fresh cuttings can also be used with success.

American and hybrid filberts (*Corylus americana, C. americana* × *avellana*)

The American filbert, or hazlenut, is a native shrub occurring from New England to Montana and southward through the Mississippi Valley and Eastern States to northern Louisiana and Florida. The hybrid filbert is a cross between the American species and the European filbert. The latter is the commercial filbert, which is grown in this country in the Northwest but is not hardy elsewhere in the Northern States. The hybrids used in the soil conservation plantings in the Northeast were produced from seed grown at the New York State Agricultural Experiment Station at Geneva.

The two filberts look much alike, both being upright, rather thickly branched shrubs. Height is 9 to 12 feet, averaging somewhat less for American filbert than for the hybrids. The leaves are roughly heart-shaped, hairy-surfaced, irregularly and doubly toothed along the margin, pointed at the tip, and about 3 to 5 inches long. They arise singly and alternately on the branchlets. The male catkins appear in the fall, ripen in early spring, and are from 1½ to 2½ inches long when ripe. The inconspicuous purplish-red styles of the female flowers appear at the tips

of heart-shaped lateral buds early in the spring before the leaves develop. The fruits are husk-covered edible nuts in clusters of one to six nuts. The husk extends beyond the tip of the nut in the American filbert, but usually fails to cover the end of the nut in the hybrid. The nuts vary in diameter from ¼ to ⅝ inch for the American filbert and ½ to 1 inch for the hybrid.

Examinations of 46 plantings ranging from 5 to 11 years old were made in seven States—Maine, Massachusetts, New York, Pennsylvania, New Jersey, Maryland, and West Virginia. Survival was excellent in 20 plantings and good in 13 others. Nine plantings had poor survival. Four of the failures were caused by a combination of exceedingly sterile soil and active erosion. Wet soil combined with the competition of rankly growing grass accounted for another. Failures in Kent County, Md., indicate that these filberts may be unsuited to the lower Coastal Plain, but more evidence is needed to establish the geographic range in this section. All other failures were due to adverse site conditions.

Growth is rapid in good soils, poor on sterile soils. Two plantings made at the same time on a farm in Wyoming County in western New York illustrate the effect of site on growth and survival. One planting was near the bottom of a moist, stabilized gully; the other on a bare, dry, eroded knoll about 100 feet distant. At the end of 7 years the filberts planted in the gully had excellent survival, an average height of 94 inches, a maximum height of 12 feet, and very good form. Those on the galled area had poor survival, an average height of 20 inches, a maximum height

FIGURE 14.—A 3-year-old shrub border of mixed species growing on Sassafras soil in southern Maryland next to a woodland. Hybrid filberts are in the third row between the bicolor lespedeza and silky dogwood of the first two rows and the autumn olive next to the trees.

of 60 inches, and a weak, spindly form. In general, growth on good sites should average 10 to 12 inches per year until the plants reach maturity.

Filberts should not be planted on poor or wet sites.

Vigorous plants of good form which attain a height of 60 inches or more in 6 years start maturing a few nuts. Such plants should bear nut crops from the seventh season on, except in years when early warm weather causes the flowers to mature before they are free from danger of frost damage. Shrubs on poor sites have failed to set fruit in the 11-year period of observation.

The test plantings failed to show any significant differences between the American filberts and the hybrids with respect to survival, growth, and other conservation factors. Soil and climatic adaptations appear to be the same for both.

The filberts are useful for shrub borders, hedge plantings, and odd-area plantings. For use in borders they should be placed in the back rows between the lower growing shrubs and the trees (fig. 14). Spacing should be about 2 feet for hedges and about 4 feet for other types of plantings.

The hybrids generally are more desirable than the pure species for plantings because of their superior nuts. However, some American filberts should be included in each planting to assure good cross pollination.

Plantings of filberts provide fairly good wildlife shelter and good travel lanes in hedges. The nuts furnish staple food for squirrels and wild turkeys and are eaten less extensively by ruffed grouse, bobwhite quail, ring-necked pheasants, and other birds and mammals. The buds and catkins are important winter food for ruffed grouse and white-tailed deer.

The nuts are valuable for human food, those of the hybrid filbert being almost as good as the commercial product. They usually ripen in September and are soon taken by wildlife if not picked promptly upon ripening.

Shrub Lespedezas Other Than Bicolor

Although bicolor is the only shrub lespedeza recommended for general use at present, four other species—cyrto, Japan, robust, and Thunberg—can be endorsed for limited use. Both Japan and robust lespedeza have desirable qualities which may lead to their use on a more widespread scale in the future.

Cyrto lespedeza (*L. cyrtobotrya*) is somewhat smaller than bicolor, growing to a height of about 8 feet, occasionally more. It is easily distinguished by its rounder leaflets and very short flower stalks. It matures seed a little earlier than bicolor but the difference in maturity is not consistent enough to be significant. The seeds are as good as those of bicolor for game food. Measurement of 22 plantings and seedings in areas ranging from West Virginia and Delaware to New York and Massachusetts showed this lespedeza to be much less dependable than bicolor as to survival, and somewhat slower in growth. Nevertheless, many good stands have been obtained and it can be grown with moderate success.

Japan lespedeza (*L. japonica intermedia*) is the smallest of the shrub species now in use for conservation plantings, attaining full height ordinarily at 5 to 6 feet, occasionally more. It tends to die to the crown

annually, renewing its entire growth the following season. The seeds are shiny black. Some strains now in use mature 2 to 3 weeks ahead of the common type of bicolor. Initial feeding trials indicate that it is good quail food. Survival and growth in field trial plantings from West Virginia to Massachusetts have been uniformly good, only one planting in Vermont having failed to survive satisfactorily. Plantings attain full stature in 3 or 4 years but do not dominate the site as quickly as bicolor unless the plants are very close together. This species may prove widely useful where a low-growing type is desired.

Robust lespedeza (*L. robusta*) resembles bicolor in most respects. It is rapid growing and under good conditions attains site domination in 3 years. Survival generally has been excellent. Seeds mature somewhat earlier than those of bicolor. Although little is known of its potentials, the plant can safely be used in areas where bicolor is adapted.

Thunberg lespedeza (*L. thunbergi*) is a tall species with somewhat more open growth than bicolor. Survival generally has been excellent and growth rapid. Stands in reasonably good soils reach site domination in 3 or 4 years. Although this species can develop good cover, it matures seed generally a little later than bicolor and for this reason is unlikely to be of much use for conservation purposes in areas north of Maryland.

The cultural requirements of all these lespedezas are the same as for bicolor.

Amur privet (*Ligustrum amurense*) and California privet (*L. ovalifolium*)

The Amur and California privets were introduced originally from northern China and Japan, respectively. They are upright, thickly branched shrubs reaching a height of 15 feet or more. The oblong leaves are from 1 to 3 inches long. The flowers are in small white clusters that bloom in June and July. The fruits are blue-black, ripening by October.

These privets are recommended for use as cropland windbreaks or tall hedges. California privet has long been used for these purposes in New Jersey, Delaware, and Maryland. In general, it should be used in preference to the Amur in the area to which it is adapted. Being semi-evergreen, it is superior to the Amur for windbreaks. However, it is hardy only as far north as the southern half of New Jersey and southern Pennsylvania. Amur privet should be used farther north. The "Amur River North" strain is hardy at least as far north as central New York and New England.

Privets are not plants for poor soils and should be used only where they can be given the best of treatment. The effect of improper site selection and planting treatment on the establishment of privet windbreaks is indicated by the results obtained in two plantings in eastern Maryland. No fertilizer or cultivation was used and neither site was prepared properly for planting. The plants grew to heights of only 25 inches and 39 inches, respectively, in 5 years, and only one planting had good survival.

These privets should be planted 12 to 18 inches apart in single rows. The ground should be plowed before planting. Each plant should be fertilized when planted with about a tablespoonful of a complete inorganic fertilizer. The planting should be cultivated once or twice a season for at least 2 years. A second application of fertilizer should be made the second spring.

Only productive, well-drained soils are suitable for these plants. With proper planting and the use of 1- or 2-year-old seedlings, growth should be rapid, averaging at least a foot each year. Hard-wood cuttings can be used if given the best of handling.

Halls honeysuckle (*Lonicera japonica halliana*)

Halls honeysuckle, an oriental species that has become widely established in the Eastern States, is the common vine honeysuckle prevalent in many parts of Pennsylvania, Delaware, and Maryland. The twining branches have semi-evergreen, ovate leaves. The flowers are white, turning to yellow later. The black fruits are largely retained on the plants into the winter.

Halls honeysuckle is one of the best species for stabilizing road banks but cannot be recommended for general use south of central Pennsylvania because of its aggressive growth habits. It is easy to plant, grows rapidly, and covers the bank with a thick, low mantle of vegetation.

Although it has been much used in road-bank plantings, not only by the Soil Conservation Service but by State and local highway agencies, only a few measured records of growth are available, partly because of the difficulty of measuring growth in the tangle resulting from the prolific layering of the stems. Growth of stems, including the layered parts of stems, in a road-bank planting at Sherrard, W. Va., averaged 6 feet at the end of 7 years. The plants had made a complete ground cover. Plantings on the Pennsylvania Turnpike averaged 64 inches in 3 years. Survival is almost always very high provided the planting is done properly. Since natural stands are available in many regions, plantings usually are established more easily and cheaply by the use of wild plants than with nursery stock. Planting stock may be obtained by scything a solid ground cover of honeysuckle close to the surface of the ground and then digging the plants up in clods. The clods may then be planted in contour furrows. A spacing of about 3 feet between lines of clods is suggested for the planting of highway banks.

Amur honeysuckle (*Lonicera maacki*)

Amur honeysuckle, an upright shrub introduced from Manchuria, grows to a height of 15 feet or more and is similar to Tatarian honeysuckle in foliage. The flowers, like those of Halls honeysuckle, are white, turning to yellow. The red fruits ripen in September and October.

A number of plantings made in raw gullies in Steuben County, N. Y., in 1937 were uniformly successful, both survival and growth rate being outstanding in spite of the poor site conditions. In three of these plantings, after 13 seasons, growth averaged 12 feet, survival was good to excellent, and the plants had practically dominated the sites. Good crops of fruit were produced annually after the stands were 4 years old. In 1939, two plantings were made in York County, Pa. Survival at the end of 11 years was excellent and growth averaged 11 feet. Fruiting began the third year. Plant form in all of these plantings was very good.

In succeeding years, in several States from Maine to West Virginia, a number of test plantings were made of Amur and Tatarian honeysuckles grown in adjacent plots. Observations after 2 to 7 years showed that the

Tatarian was uniformly the better. Growth rate of the two species was about the same, but the survival rate of Tatarian was consistently higher than that of Amur. Since the species are quite similar and serve essentially the same purpose, only the Tatarian is now recommended for general use. However, where a taller honeysuckle is wanted, or variety is desired, the Amur can be used. Cultural methods are the same for both species.

Bessey sand cherry (*Prunus besseyi*)

Bessey sand cherry is a bush cherry native to the northern Great Plains from Kansas to Manitoba. It is an upright, semispreading shrub reaching a height of 3 feet or possibly a little more. The sea-green leaves are 1 to 2½ inches long, the flowers white, and the fruit dark red, sweet but somewhat astringent, and about ¾ inch in diameter. The fruit makes good jelly and preserves for home use and is a potential source of wildlife food.

Initial test plantings at 36 locations have shown the ability of this plant to thrive on poor sites. A 5-year-old planting on sterile coal-strip-mine spoil in Clarion County, Pa., had three-fourths of the original plants living and an average height of 36 inches. The tallest plants were 48 inches high and all plants were bushy, vigorous, and well formed. They fruited heavily after 3 years. Reproduction by stolons had started in the second growing season. In Vermont, on a raw, active sandblow, 75 percent of the plants were living after 5 growing seasons. They averaged 59 inches in height and the tallest plants were 70 inches high. They were bushy, had numerous stolons, and dominated their sites. This plant appears to be especially well adapted for revegetating areas of the types mentioned.

A 6-year-old planting on poor, wet Volusia soil in Allegheny County, N. Y., had 94-percent survival and an average height of 28 inches. After 11 years 75 percent of the plants were still alive and average height was 36 inches. Two- and three-year-old plantings from Maine to West Virginia show similar early results, most plantings being about 15 inches high after the second growing season. The growth rate thereafter increases slightly if competition is not severe. On poor sites where herbaceous weeds establish themselves easily the sand cherry may be unable to dominate the site.

Hybrids of sand cherry × wild plum (*P. besseyi* × *americana*) were planted in 1944 and 1945 at three locations in New York, Vermont, and Pennsylvania for the purpose of comparing the hybrids with true sand cherries planted nearby. In this limited comparison the hybrids displayed no marked superiority over sand cherry. Their height growth was slightly more rapid, and they showed the dominance of the plum parentage in form and fruit as well as in height. However, the survival rate of the hybrids was much poorer than that of sand cherry.

Both sand cherry and the hybrids appear to be well adapted for planting on mine spoils and sand blows but are not recommended for other types of plantings. Infection by brown rot can be expected. Sand cherry, moreover, is subject to a number of insect and disease pests that commonly affect related species of commercial cherries, and its general use in farm plantings may be objectionable. On fruit farms it should be given the same spray treatment used for the cultivated fruits.

Rugosa rose (*Rosa rugosa*)

Rugosa, an upright rose introduced from northern China, has been widely used in the development of horticultural rose varieties. It grows to a height of about 6 feet and has stout stems covered with very numerous, rather weak thorns. The flowers are 2 to 3 inches across and, though usually red, may range in color from white to purple. The plants flower throughout the summer. The fruits, which resemble small red tomatoes, vary in size from ¾ inch to 2 inches in diameter. Fruiting begins about the third year and is generally heavy. The shrub is hardy throughout the Northeast.

In the erosion-control work of the Soil Conservation Service its use has been restricted almost entirely to road-bank plantings, for which it is well suited. Road-bank plantings in central Maryland have grown to an average height of 50 inches in 7 years and have succeeded in dominating the planting sites mainly through prolific reproduction by stolons. On the Pennsylvania Turnpike, height growth of 6-year-old plantings averaged 24 inches and reached a maximum of 36 inches. Plantings at eight other locations in West Virginia, Maryland, Delaware, New York, and Vermont generally had satisfactory survival rates, an exception being a New York planting on heavy, poorly drained soil where only one-half of the original plants were still living after five growing seasons. Survival rates in the other plantings 2 to 5 years old were 75 percent or better.

Another special use for rugosa rose is the control of bank cutting on storm-lashed seashores. The plant is one of the few shrub species that can withstand salt spray.

Rugosa rose could probably also be used in borders, wildlife areas and certain other plantings for which other roses up to the present time have been assumed to be better. Studies of the various roses to determine the relative food values of the fruits for wildlife, and further observations of rugosa rose itself, are needed to determine the comparative value of the various species for these purposes.

For road-bank and seashore plantings either 1-year-old seedlings or rooted cuttings, spaced about 2 feet apart, should be used.

Wichura rose (*Rosa wichuriana*)

Wichura rose, a semi-evergreen rose introduced from the Orient, has prostrate, trailing branches; fragrant, white flowers about 2 inches across; and oval red fruits. It has been used mainly for planting banks and rocky slopes.

It is an ideal plant for conservation plantings on road banks, the tendency of the creeping branches to layer freely and form new plants resulting quickly in a complete bank cover. Its low-growing habit prevents it from becoming a visibility hazard along roadways, even when growing close to the edge of the road.

Six-year-old plantings on the Pennsylvania Turnpike had stem growths averaging 86 inches in length. Survival was very high, and the plantings had practically reached the stage where new layered plants could not be distinguished from the originals. In another road-bank planting in Franklin County, Pa., after 7 years, stem length averaged 6 feet and the

old and layered plants formed a complete bank cover. Fruiting began in some plants in about their third year.

Plantings on road banks should be made in level rows with a spacing of 2 to 3 feet between rows and between plants in the row. The plant can be used throughout the Northeast with the possible exception of the northern parts of New York and New England.

Coralberry (*Symphoricarpos orbiculatus*)

Coralberry, or Indian currant, is a native plant occurring from New York to the Dakotas and southward to the Gulf of Mexico. Although better suited to the Midwest, it has done well in plantations east and north of its natural range in the Northeastern States.

It grows to a height of 4 to 6 feet with several slender main branches arising at the ground surface and with many fine side branches. Thus, although the shrub has an upright habit of growth, it is also quite spreading. The main stems have shreddy bark. The leaves are oval and about 1 to 2 inches long, have very short petioles, and arise in opposite pairs. The small flowers are borne during midsummer in groups in the axils of the upper leaves. The dark-red fruit clusters ripen in September or October and hang on the plant all winter. Each fruit is oval-shaped and about ¼ inch long (fig. 15).

Coralberry forms dense thickets through its ability to form new plants

Figure 15.—The fruits of the coralberry remain on the plants during the winter and are used by wildlife for winter food.

by layering—a habit of growth that makes the shrub an unusually good erosion-control plant. But since layering also enables the plants to spread into crop fields or pastures, the advisability of planting coralberry in or near such places should be carefully weighed. Although observations to date indicate that it is not aggressive enough in the Northeast to be a pest, its best use for the present is restricted to types of plantings which involve no risk to cultivated farm crops.

Coralberry was one of the most widely used shrubs in the erosion-control work of 1937 to 1940, having been used extensively on the most unfavorable sites, particularly raw gullies. The 70 plantings from 5 to 13 years old that were observed and measured were notably successful.

In only 2 of the 16 plantings observed in southern Pennsylvania was survival less than 70 percent, and in 10 it exceeded 85 percent. After 5 years it was difficult to determine survival because many new plants had reproduced and spread by layering. Most of the plantings had attained complete site domination. Growth varied with soil fertility. The plantings on raw eroding subsoil grew about 20 inches in 3 years, 25 inches in 5 years, and 29 inches in 7 years. In contrast, plantings on good sites in borders, hedges, and odd areas grew 32 inches in 3 years, 37 inches in 5 years and 48 inches in 7 to 8 years. The best planting—a border near Apollo in western Pennsylvania—averaged 63 inches, some plants making 74 inches.

In New York, 24 plantings from 5 to 8 years old were measured. Seven were in the western counties, mainly Cattaraugus and Wyoming; the others in central and east-central counties—Steuben, Tompkins, Madison, and Chenango. Results were highly satisfactory, though not quite as good as in Pennsylvania, especially as to growth and site dominance. Twenty plantings had good or excellent survival.

The best growth—that of a border planting near Wallace in Steuben County—was 50 inches in 7 years. The average growth in 7 years was only 32 inches, the poorest 21 inches. Despite the rather poor growth rates, most of the plantings attained a fairly dominant stand. Because of the spreading habit of coralberry, the height and size of individual plants is of less importance than in most species.

Several factors, including the small size of the planting stock and faulty planting techniques, adversely affected many of these plantings. Many plants had been only 1 year in the nursery and were as slender as grass stems. Poor planting caused slow growth in some places. Some plantings failed simply from having been smothered by grass. Improved results can be expected in future plantings as the requirements for successful planting become better recognized.

Good results were obtained in five of seven plantings observed in New Jersey; survival was nearly perfect and average growth was 3 feet after 5 to 7 years. Five plantings in northern Delaware all had good survival and growth. Growth averaged 41 inches in 7 seasons, and all plantings through layering and other means had attained site domination. In Maryland, nine plantings were observed over a period of 7 years. Survival was 70 percent or more in seven plantings and average height in 6 or 7 years was 41 inches. Coralberry dominated the site in three of the plantings. The failure of two plantings was attributed to the extreme dryness and sterility of the sites, aggravated in one case by injuries caused by the grazing of domestic animals.

Coralberry has not been planted extensively in West Virginia, largely because of fear that it might become a pest. Results in two 1937 plantings near Moundsville in the northern Panhandle area were comparable with those in adjacent states. Growth averaged 3 feet in 8 years and the spaces between plants had filled up fairly well through natural spreading. Plantings in northern New England were hardy but growth was slow and ultimate site domination doubtful.

Fruiting of thrifty plants began about the third year and was dependable thereafter.

The few planting failures were scattered throughout the region and were apparently due more to improper planting or poor stock than to differences in climate or unfavorable soils. Even some of the very poorest sites—dry and sterile—though seldom giving quick growth and rapid coverage, finally produced satisfactory stands.

One of the reasons accounting for the wide use of coralberry in many parts of the Northeast is its normally low height. This and its layering ability have made it one of the very best plants for controlling erosion on road cuts and fills. It can be used in the outer row of wildlife borders or for planting gullies and other odd areas which have soils that are not excessively dry or sterile.

Because of its thicket-forming ability it makes a good type of low, shrubby wildlife cover used extensively by birds for nesting. The fruits provide an emergency winter food for pheasant, quail, ruffed grouse, wild turkey, deer and at least six kinds of songbirds (fig. 15). Though not taken eagerly when food supplies are adequate, they stay available on the bushes for use in times of heavy snow when the better foods are scarce.

Although the primary value of coralberry rests in its ability to control erosion and furnish wildlife cover, its natural attractiveness has led to its wide use as an ornamental.

It should be planted as 2-year-old nursery-grown seedlings. On road banks and in gullies it should be spaced 2 feet apart; in borders and wildlife-area plantings, 3 feet. Center-hole planting in furrows or scalped spots is the best planting method. No cultivation is needed. Maintenance involves only the occasional removal of encroaching tree seedlings.

Arrowwood viburnum (*Viburnum dentatum*)

Arrowwood is a native viburnum occurring from New Brunswick to Minnesota and south to Georgia. It is upright, many-branched, and reaches a height of 10 to 12 feet, occasionally more. The ovate leaves, coarsely toothed on the margin, are 2 to 4 inches long. The white flowers appear in flat-topped clusters 2 to 3½ inches across. The blue-black fruits ripen in October, dropping to the ground soon afterward.

This viburnum has been used widely in conservation plantings from Vermont to Delaware and West Virginia with generally satisfactory results. It has done nearly as well as some of the shrubs recommended for general use, but since it has comparatively few utility values, plantings are suggested only for special purposes where its particular qualities are wanted—mainly as wildlife-area plantings or borders and hedges intended primarily for wildlife benefits.

Twenty-five plantings 6 to 12 years old have been measured and observed periodically during their development. Twenty of these had 55 percent or more plants living of which 13 had survivals ranging between 70 and 85 percent. In two plantings arrowwood was so mixed with other species that survival could not be determined. Only three plantings failed to have satisfactory survival. In two of the failures—one in New York and one in Pennsylvania—growth was average and survival fair. The other failure, in which survival was only 50 percent, was in Vermont on an active sand blow, a site on which this species would not be expected to thrive.

Average growth varied from 38 inches in nine New York plantings to 67 inches in six Pennsylvania plantings and 50 inches in seven areas in Delaware, Maryland, and West Virginia. The tallest plants had grown to a height of 10 feet in 12 growing seasons.

The form of the plants in most plantings was rated fair to good. It was found that several years are required for the plants to bush out well. Sparse fruiting may begin in the fifth or sixth year, but in most areas fruiting had not begun even at 7 or 8 years. Only two plantings, both in western New York, had reproduced sparingly by sending out a few stolons.

Proper planting is important with this as with other viburnums. Three-year-old plantings on a plowed site in New York made a growth of 24 inches whereas those planted in scalped spots grew only 13 inches. The growth rates can undoubtedly be increased by the use of improved planting techniques.

Arrowwood viburnum, when intended for wildlife food and cover, can be planted as borders or wildlife areas using a 4-foot spacing, or as hedges with 1-foot spacing. The planting site should be prepared by furrowing, if possible; at least, the sod should be thoroughly scalped. Only fairly fertile and either well-drained or moist soils are suitable for this species.

Nannyberry viburnum (*Viburnum lentago*)

One of the taller viburnums, the nannyberry is native from eastern Canada to Manitoba and south to Georgia and Mississippi. On suitable sites it reaches a height of 25 to 30 feet. The ovate leaves are 2 to 4 inches long and pointed at the tip. The white flowers are in flat-topped clusters about 3 to 5 inches across. The oval fruits when ripe are blue-black with a bloom on the surface, and about ½ inch long. They ripen in early fall and drop to the ground before winter.

Plantations of nannyberry from 2 to 13 years old, most of which were in borders or gullies, have been observed and measured in New York, Connecticut, Pennsylvania, Delaware, and Maryland. Of 20 plantings, 15 had good or excellent survival. There were no significant differences in growth rate or survival due to geographical location. The average 6- to 8-year height growth was much the same in all States, ranging from 41 to 45 inches, but growth varied markedly with quality of site. Some of the plantings had been severely set back by the browsing of livestock.

The plants, though generally well proportioned, were more treelike than bushy. None of the plantings even approached site domination. Those in borders, which usually were on the more fertile sites, had distinctly better growth and survival. In fact, most of the satisfactory sur-

vivals and all the best ones were in borders, whereas not more than half the gully plantings had satisfactory survival. Heights averaged 10 inches more in borders than in gullies, and plant form and vigor were markedly superior on the better sites.

A few plants had stoloned and only one planting, a 7-year-old border near New Bethlehem, Pa., had reproduced through seedlings. Three other plantings had set their first fruit in the eighth season, a sparse fruiting in each case.

Though not recommended for general use, nannyberry viburnum can be planted on productive sites on the inside part of borders next to the trees. It contributes variety to the food supply of wildlife and to the appearance of the border.

Plantings should be confined to well-drained and fairly fertile soils. Two-year-old nursery-grown seedlings should be used. Planting should be at 4- to 6-foot spacing either in plowed ground or in large scalped spots.

Blackhaw viburnum (*Viburnum prunifolium*)

Blackhaw viburnum, a moderately tall shrub reaching a height of 15 or 20 feet, is native from Connecticut to Michigan and south to Florida. It has rather spreading branches and ovate leaves 1 to 3 inches long. Pure white flower clusters appear in May. The bloomy blue-black fruits are about ½ inch long, ripen in October, and drop to the ground before winter.

This shrub can be used with moderate success in border plantings from Pennsylvania southward, its purpose and place in such plantings being much the same as those noted for nannyberry.

Of 24 plantings in New York, Pennsylvania, New Jersey, Maryland, and West Virginia, 16 had good or excellent survival. Five were complete failures, including three of the five New York plantings.

Height growth in these plantings was generally slow, averaging only 32 inches in a 6- to 8-year period. Best results were obtained in Lancaster County, Pa., where the average growth of nine plantings was 42 inches. The best was a border planting in which the growth averaged 92 inches at the end of the eighth season.

Practically all the acceptable plantings were in borders, the poorer ones usually in gullies. The plants were generally treelike in form and rather sparsely branched. None of the plantings had approached domination of the site or reproduced in any way, nor had they fruited in the 6 to 8 years after planting.

This viburnum is recommended for limited use only on well-drained productive soils in areas where it is desired to add variety to the food for wildlife. Planting should be carefully done, as recommended for nannyberry.

American cranberrybush viburnum (*Viburnum trilobum*)

American cranberrybush viburnum, a native species sometimes called highbush cranberry, is found from Newfoundland to British Columbia, southward in the Midwest through the eastern Dakotas to Missouri, thence to West Virginia and New Jersey. Its distribution is rather

FIGURE 16.—*A*, Cranberrybush viburnum is shown here growing in a farm hedge between cropland and pasture. It is one of several viburnums useful in conservation plantings, but must be protected from grazing animals by fences when used next to pasture. *B*, The fruits ripen in early autumn and tend to remain on the branches during the winter.

scattered throughout much of its range, especially in the southern portion and in the intensively farmed areas.

It is one of our most beautiful native shrubs, well branched, upright in form, and growing to a height of 6 to 10 feet, occasionally more on ideal sites. The bark is grayish-colored. The leaves are opposite, three-lobed like maple leaves, and from 2 to 5 inches long. The flowers appear in late May and early June. Each bloom is a creamy-white cluster 3 to 4 inches across, composed of an outer ring of large flat flowers and an inner ring of tiny flowers. The fruits resemble true wild cranberries in size and color, but are more translucent when ripe. Ripening in September and October, they hang on the branches all winter.

The plants tend to remain single, sometimes sending out stolons but never layering. Reproduction is by seed and an open seedbed is necessary for germination. There is no danger of planted shrubs spreading to other areas.

Plantings have been fairly successful. Observations were made of 25 plantings 5 to 11 years old in Vermont, Massachusetts, New York, Pennsylvania, Delaware, Maryland, and West Virginia. In only 5 was survival less than 70 percent.

Growth rates in these plantings differed greatly, due probably to differences in soil fertility. The small size of the planting stock in the older plantings also probably influenced the rate of growth, especially where plant competition was acute. This plant has a tendency to grow slowly at the start and to speed up growth after 3 to 4 years. In the better plantings, the average growth was 24 to 30 inches in the first 3 years, 4 to 7 feet in 7 years. On poor sites it took 5 years to reach heights of only 18 to 26 inches.

The plants had good form, and all except those of slow growth were well-branched and vigorous. The larger plants began to flower and fruit in the third year. Most plantings fruited satisfactorily in about the fifth year (fig. 16).

Highbush cranberry is recommended for limited use in borders, hedges, windbreaks, and in odd-area wildlife plantings. Although it withstands wet soil, the soil should preferably be well drained and must be reasonably fertile. Either acid or alkaline soils are suitable, but not dry or very unproductive ones.

Since the species does not spread rapidly from the roots, it will not take over the planting site unless the individual plants are closely spaced when first planted. For hedges, a 1- to 2-foot spacing is recommended; for windbreaks, 3 feet; and for borders and wildlife areas, 3 to 4 feet. In borders or wildlife-area plantings this plant usually fits in best when used in the third or fourth row between the low shrubs next to the open field and the trees farther back.

Hedge and windbreak plantings benefit from the application of fertilizer in the year of planting, a cultivation after fertilization, and another cultivation the following year. Maintenance requires the occasional removal of any tree seedlings that become established in the planted area.

Two-year-old nursery-grown seedlings should be used. Best results in planting are obtained by plowing the entire site, or plowing a double furrow for each row of plants. At the very least, a square foot of any competing sod should be removed for each plant. Plantings must be fully protected from grazing.

SHRUBS TESTED BUT NOT RECOMMENDED FOR USE IN CONSERVATION PLANTINGS

The experience gained in shrub-planting work showed that certain species are unsuitable for conservation planting in the Northeast. Although the scope of the trials of some of these species was very limited, the information gained was sufficient in all cases to provide an adequate basis for evaluating the suitability of the various plants. Species which failed to give good results, and therefore cannot be unqualifiedly recommended, are described below. Plantings of these species in other parts of the country, under other circumstances, or for different purposes might prove successful.

Actinidea arguta	Bower actinidea
Albizzia julibrissin	Silktree albizzia
Amelanchier canadensis	Shadblow serviceberry
Amelanchier oblongifolia	Thicket serviceberry
Amorpha fruticosa	Indigobush amorpha
Amorpha glabra	Mountainindigo amorpha
Ampelopsis brevipedunculata	Amur ampelopsis
Aronia melanocarpa	Black chokeberry
Berberis thunbergi	Japanese barberry
Caragana arborescens	Siberian peashrub
Celastrus orbiculata	Oriental bittersweet
Colutea arborescens	Common bladdersenna
Cornus bretschneideri	Bretschneider dogwood
Cornus florida	Flowering dogwood
Cornus mas	Corneliancherry dogwood
Cotoneaster divaricata	Spreading cotoneaster
Daphne mezereum	February daphne
Diospyros virginiana	Common persimmon
Elaeagnus angustifolia	Russian-olive
Euonymus americanus	Brook euonymus
Euonymus europaeus	European euonymus
Ilex opaca	American holly
Ilex verticillata	Common winterberry
Ligustrum ibota	Ibota privet
Ligustrum vulgare	European privet
Lonicera bella	Belle honeysuckle
Lonicera muendeniensis	Muenden honeysuckle
Lonicera notha	Rutarian honeysuckle
Lonicera syringantha	Lilac honeysuckle
Lycium halimifolium	Matrimonyvine
Malus sargenti	Sargent crabapple
Morus alba	White mulberry
Morus rubra	Red mulberry
Parthenocissus quinquefolia	Virginia creeper
Prunus americana	American plum
Prunus japonica	Chinese bushcherry
Prunus tomentosa	Manchu cherry
Quercus ilicifolia	Scrub oak
Rhus copallina	Flameleaf sumac
Rosa eglanteria hyb.	Hybrid sweetbrier rose

Rosa pisocarpa	Peafruit rose
Rubus parvifolius	Trailing raspberry
Salix sp.	Willows
Sambucus canadensis	American elder
Sorbus americana	American mountainash
S. aucuparia	European mountainash
Staphylea pinnata	European bladdernut
Symphoricarpos albus	Common snowberry
Taxus canadensis	Canada yew
Viburnum acerifolium	Mapleleaf viburnum
Vitis vulpina	Frost grape

Bower actinidea (*Actinidea arguta*)

Bower actinidea is an exotic, climbing vine bearing edible fruit. Three test plantings, two in New York and one in West Virginia, had low survival and no height growth in the first 2 years, and all plants subsequently died.

Silktree albizzia (*Albizzia julibrissin*)

An 8-year-old planting near Spencer, W. Va., survived well. Height growth averaged 83 inches and some seeds were produced. It had not dominated the site, however, and had reproduced only slightly by stolons. Another planting near Point Pleasant, W. Va., grew to a height of 84 inches in 5 years but only half the plants survived. This species could be established, apparently, in the Maryland-West Virginia zone at low altitudes but it does not seem to offer as much promise of usefulness as other woody legumes.

Shadblow serviceberry (*Amelanchier canadensis*)

A test planting in York County, Pa., failed completely; another, near Ithaca, N. Y., had only 5-percent survival and no height growth at the end of 4 years. One near Albany, N. Y., had good survival but grew to a height of only 18 inches in 9 years. This plant shows little likelihood of being successful in field plantings.

Thicket serviceberry (*Amelanchier oblongifolia*)

Six test plantings gave consistently poor results. After 5 years the plants were only 7 to 23 inches tall and of poor form and vigor. Survival was from 45 to 80 percent. This plant shows no promise of successful use in field plantings.

Indigobush amorpha (*Amorpha fruticosa*)

Indigobush amorpha, a native leguminous shrub, is found naturally from southern Pennsylvania to Minnesota and south to Texas and Florida. It is upright but rather straggly and open-branched. Although it is said to reach a height of 18 feet, the tallest specimen observed in the Northeast, growing in an 8-year-old planting at Spencer, W. Va., was 13 feet. The foliage resembles that of black locust. Flowers are purplish

blue and brown in clustered spikes from 2½ to 6 inches long. The spikes bear the seeds in small pods, one seed in each pod.

The shrub was widely used in Soil Conservation Service plantings in 1937 and 1938. Twenty of these situated in New York, Vermont, Pennsylvania, Delaware, New Jersey, Maryland and West Virginia have been observed and measured in the succeeding years. Survival in nearly all of the plantings was good or excellent, equaling that of any shrub used. Only two plantings—one near Oxford, N. Y., the other in northern Vermont—failed to produce a satisfactory number of living plants.

Growth rate was good to excellent except in New York and Vermont. In Pennsylvania, Delaware, Maryland, and West Virginia, the height averaged 4 feet at the end of the third growing season, a little over 5 feet at the end of the fifth, and 7 feet at the end of the seventh or eighth. In New York and Vermont the average rate of height growth was much slower—only 4 feet in 7 years with no growth increments in the following years. In these northern areas, considerable winter damage occurred.

Although the shrub reproduces by seed and a number of plantings had produced seedlings in 3 or 4 years after planting, efforts to establish plantings by direct seeding have been disappointing.

In West Virginia the shrub has been known to spread vigorously enough to become a nuisance. No undesirable spreading has occurred farther north.

The best characteristic of amorpha is its ability to survive and grow on unfavorable sites such as raw gullies and road banks. However, the form of the plant is rather poor and its wildlife-cover value is inferior to that of most shrubs of its size. It is almost useless as wildlife food. Hence, it has little to endorse it.

Tennessee indigobush amorpha, a subspecies, was found to possess no superior characteristics for conservation purposes.

Mountainindigo amorpha (*Amorpha glabra*)

This amorpha offers no advantages over indigobush, which it closely resembles. Although it has survived and grown reasonably well in 17 test plantings, it is inferior to indigobush in both growth and form.

Amur ampelopsis (*Ampelopsis brevipedunculata*)

Amur ampelopsis, a climbing vine, was a failure in the four areas in New York and Pennsylvania in which it was tested. In each instance the tops of the plants died back each winter and all plants finally died. A few plants made enough growth in a single season to mature a few fruits, but subsequently succumbed to the cold.

Black chokeberry (*Aronia melanocarpa*)

Black chokeberry has been used in borders and hedges, on road banks, and in wildlife-area plantings with very limited success. Survival generally has been good or excellent and height growth has been fairly rapid, reaching 15 to 20 inches in 3 years and 25 to 48 inches in 7 to 9 years. Fruit has matured in 2 or 3 years after planting, occasionally the first season. No geographical limitations have been noted, and the plant

seems to be adapted to a wide variety of soils. Reproduction by stolons has thickened the stands very little. None of the plantings reached site domination in 12 years, nor did it appear probable that the plantings would ever control their sites. The plant gave little evidence of value for erosion control and wildlife cover, and its use for conservation planting in most areas, therefore, is not generally recommended.

Japanese barberry (*Berberis thunbergi*)

The familiar Japanese barberry is much used in ornamental planting, partly because of its freedom from black stem rust. It has been widely used in trial conservation plantings for the same reason and because of its thorny cover for wildlife and the limited value of its fruit as a winter food for wildlife. Field plantings in general, however, have failed to produce good results. Of 31 plantings 5 years old or more, 17 had unsatisfactory survival and many of these had very few living plants. Growth and form were likewise poor. Average height was 28 inches in 5 to 7 years and 39 inches in 12 years. Form generally was straggly, and no planting attained or even approached site dominance. Although some plants began to fruit about the fourth year, fruiting was very erratic and few of the fruiting plants had high yields.

None of the barberry hedges tested for use as living fences against livestock proved to be adequate for this purpose.

The consistently poor results obtained in conservation plantings of barberry, as compared with the ease with which this shrub is established in the landscaping of home grounds, are probably due to the low productivity of the soil and the competition of other plants in the field planting areas. Cultivation and planting in fertile soil would undoubtedly produce better results.

Many plantings, supposedly of Japanese barberry, actually contained hybrids of European barberry, a species that carries the black stem rust. The seed used had evidently been collected from sources subject to cross pollination. Although cross fertilization could be avoided by proper attention to seed sources, the impracticability of continually guarding against hybridization is an added disadvantage of using this species.

Siberian peashrub (*Caragana arborescens*)

This leguminous shrub, though widely used in the Northeast in 1937 and 1938, was a complete failure in almost every trial. Of the many plantings observed, only three in New York and one in Pennsylvania had living plants after 5 years. Two of these had only two plants remaining, the other two had only fair survival. Plant form and height growth were poor. The plant holds little promise of usefulness in conservation plantings in this part of the country.

Oriental bittersweet (*Celastrus orbiculata*)

Oriental bittersweet, which is very similar to the native bittersweet, has no advantages over the native species for conservation plantings. Plantings of the two species side by side demonstrated that the American bittersweet is somewhat more dependable as to growth in field plantings, but neither plant is satisfactory for general use.

Seven test plantings in New York, Pennsylvania, Maryland, and West Virginia have been observed from 2 to 7 years. All but one survived well. However, height growth was generally poor, varying from 2 to 9 feet in 7 years, and none of the plantings made a good cover.

Common bladdersenna (*Colutea arborescens*)

Seven test plots in areas ranging from Maine to Maryland had uniformly poor survival after 3 years. In the best planting only 10 percent of the plants were living at the end of 3 years. They were 12 inches high.

Bretschneider dogwood (*Cornus bretschneideri*)

This exotic red-stemmed dogwood, which is very similar to silky dogwood, has done well in test plantings, with highly satisfactory survival and fair growth rate and plant form. All plantings showed promise of eventually dominating their sites, although none had yet reached this stage in their sixth year.

This species appears to have no advantage over the native silky dogwood. Since its performance in plantings is poorer than that of the native plant there appears to be little place for it in conservation plantings.

Flowering dogwood (*Cornus florida*)

The possibility that this beautiful native dogwood might find wide use in conservation planting reflects a wish with little hope of realization. The plant, a moderately tall species, would be especially desirable in the rear of wildlife borders and in wildlife-area plantings because of its showy flowers and the quality of the fruits as fall food for many desirable forms of wildlife.

Field plantings, however, have not been successful. It has been tried generally from New York to West Virginia, mainly in borders but also in gullies and other odd areas. Survival in 22 plantings from 5 to 12 years old has ranged from poor to excellent, being satisfactory in only 13 plantings.

The best growth was in a northern Delaware planting, where height averaged 10 feet in 11 years; the poorest in one near Breakabeen, N. Y. that averaged only 17 inches in 9 years. Most plantings had grown only about 3 feet in 5 to 8 years. None had reached site domination or even a complete canopy. Retarding factors seemed to be mainly poor soil and competition of herbaceous plants. Only two plantings—one 9 years old and the other 11—had any fruiting plants. Plant form was rather open and treelike as may be expected with this species.

Although fair results can be attained by planting flowering dogwood to "sweeten up" borders, the plant cannot be recommended as a conservation-planting species because of its slow growth, undependable survival, and inadequacy for erosion control.

Corneliancherry dogwood (*Cornus mas*)

Test plantings of this exotic dogwood in New York, Pennsylvania, and Maryland have given consistently poor results. Most of them were com-

plete failures. Two of the New York plantings had good survival but made no appreciable height growth in 5 years. The shrub seems to have no promise of usefulness for conservation plantings.

Spreading cotoneaster (*Cotoneaster divaricata*)

Of four trial plantings made in Maine, Vermont, New York, and Pennsylvania, respectively, two were complete failures and two had good survival. On heavy, acid, poorly drained soils in New York which are unsuited for most species, the shrub grew to a height of 36 inches and had a full, bushy form in 10 years. Fruit yield was fair.

This species is not likely to find a place in conservation work, as even the best planting failed to approach site domination in 10 years.

February daphne (*Daphne mezereum*)

Seven plantings of February daphne made in 1936 and 1937 in central New York and western Pennsylvania were examined. All had failed within 8 or 9 years. Survival was generally poor and the best growth was only 27 inches. Although most of the plantings had been made in raw gullies on exceedingly poor sites and thus did not have the benefit of favorable growing conditions, the plant seems to have no practical value for use in conservation plantings.

Common persimmon (*Diospyros virginiana*)

Because of the high rank of its fruit as a wildlife food and its habit of pioneering on abandoned land, this tree was planted extensively in demonstration work in Pennsylvania, West Virginia, Maryland, and Delaware from 1937 to 1939. None of the 11 plantings in these States that were examined when they were 6 to 8 years old were successful. In fact, in most of them all plants died. Only one, an 8-year-old gully planting near Sherrard, W. Va., had as many as 70 percent of its plants surviving. Although height growth averaged 45 inches, the plants had not begun to cover the site. The species has shown no likelihood of adaptability for erosion-control or other conservation planting.

Russian-olive (*Elaeagnus angustifolia*)

Of eight plantings, each 5 years old, examined in Vermont, New York, Massachusetts, New Jersey, New Hampshire, and West Virginia, all were found to have failed. Few plants lived after the first two winters, indicating lack of hardiness under the site conditions.

The consistently poor results indicate that the plant is poorly adapted for conservation planting in this region.

Brook euonymus (*Euonymus americanus*)

Two plantings in Pennsylvania had good initial survival. One, in Indiana County, grew 53 inches in 7 years but the plants were sparsely branched. The other, in York County, averaged only 27 inches in height after 6 years and died a few years later. Neither had approached site domination. The older planting bore some fruit the seventh year.

European euonymus (*Euonymus europaeus*)

Test plantings of European euonymus on State game lands in New York and Pennsylvania have shown little promise. Of nine plantings measured, only one had satisfactory survival after 11 years. Height growth was very slow, the average growth of plantings ranging from 10 to 28 inches in 5 years, 24 to 72 inches in 11 years. There was no likelihood of the plants dominating their sites ahead of natural tree growth. Some of the plantings matured a little fruit beginning in the sixth year. The species has too slow and undependable a growth in field plantings to be of practical use.

American holly (*Ilex opaca*)

Six test plantings observed over a period of 6 years in localities ranging from New Hampshire to West Virginia were all failures. Survival in all plantings except the single one made in West Virginia was very low. Growth was generally poor, the plants remaining about the same size as when planted.

Common winterberry (*Ilex verticillata*)

Winterberry was widely used in borders and odd areas from New York to Maryland between 1938 and 1940. None of the plantings proved satisfactory. Of eight plantings measured, four had barely satisfactory survival, two had poor survival, and two were complete failures. The growth rate was consistently low, averaging about 27 inches in 7 or 8 years and only 43 inches at best. No plantings even approached site domination. A few plants produced fruit beginning with the fifth year. There is little prospect of this plant becoming widely useful for erosion control or other conservation purposes.

Ibota privet (*Ligustrum ibota*)

Test plantings of Ibota privet in New York and Pennsylvania have shown little promise of success. All of the five plantings measured in widely scattered areas of New York were failures, no plants surviving after 10 years. One planting in York County, Pa., averaged 12 feet in height after 11 years. Survival rate was good and the form and vigor of the plants satisfactory. The plant might be used with fair success in southern Pennsylvania and southward, but results would probably be poorer than with Amur or California privet.

European privet (*Ligustrum vulgare*)

European privet, which was test planted in the same areas in New York and Pennsylvania in which Ibota privet was tried, was only moderately successful. A New Jersey planting was a total loss. All of the New York and Pennsylvania plantings had fair survival except two in Allegany County and one in Albany County, N. Y., in which only half the plants survived after 6 years and 10 years, respectively. Average height growth was 5 feet. A planting in York County, Pa., had the best growth—9 feet. All plants that lived were fairly well formed. Two

plantings yielded fruit in the sixth season. None dominated their sites. This species may have value for hedges and windbreaks on fairly productive soils, but extra care is necessary to enable it to hold its own against encroaching plants. It is not recommended for general use because of its many limitations.

Belle honeysuckle (*Lonicera bella*)

Five test plantings—three in New York and two in Pennsylvania—gave generally poor results. One of these, a 6-year-old planting in Allegany County, N. Y., had good survival and an average growth of 22 inches. Survival in two central New York plantings was poor; growth in 6 years was not more than 26 inches. In York County, Pa., survival was 24 percent; growth in 10 years was 60 inches. In this planting there was a good fruiting the sixth year. A planting in Lancaster County, Pa., was a failure.

Muenden honeysuckle (*Lonicera muendeniensis*)

Muenden honeysuckle was tested in three areas in New York and one in Pennsylvania. All plantings were failures marked by low survival and very little growth. The plant gave no indication of adaptability for use in conservation plantings.

Rutarian honeysuckle (*Lonicera notha*)

A central New York test planting, after 6 years, had 60 percent survival, 17 inches growth, and poor form. Another in York County, Pa., was almost a complete failure after 6 years. Average growth of the few surviving plants was 57 inches.

Lilac honeysuckle (*Lonicera syringantha*)

Six test plantings of lilac honeysuckle in central New York and southern Pennsylvania had generally fair, but widely variable, initial plant survival. The lack of winter hardiness eventually killed all the plants. There seems to be no likelihood of this species being useful in conservation plantings. Two plantings of *L. syringantha wolfi* were complete failures.

Matrimonyvine (*Lycium halimifolium*)

No plants survived in test plantings in Albany, Yates, and Schuyler Counties, N. Y., and Hunterdon County, N. J. Although more than half the plants lived for 2 or 3 years, sprouting weakly from the crown each year after the tops had been frozen back, all finally died.

Sargent crabapple (*Malus sargenti*)

A test planting in central New York had 75-percent survival and an average growth of only 30 inches in 10 years. Another, in York County, Pa., had poor survival and an average growth of 14 inches in 5 years.

White mulberry (*Morus alba*)

This fruiting tree has been widely planted in the soil conservation program for wildlife food, mainly as a tall plant at the back of shrub borders. The 20 plantings that have been measured and observed periodically provide a good indication of its qualities. They were located in southern Maine, northern Vermont, eastern Massachusetts, east-central New York, southeastern Pennsylvania, northern New Jersey, Delaware, western Maryland, and northwestern West Virginia. Both survival and height growth varied greatly. In 8 of the plantings almost no plants survived; in 4, about half the plants lived; and in 8 others, survivals were good or excellent.

Height growth was generally fairly good but far from dependable. The few plants which had survived in the poor plantings usually were fine specimens with heights up to 15 feet in 13 years. On the other hand, height growth on rather good soil, near Quarryville, Pa., averaged only 37 inches in 7 years. Two other plantings, each 13 years old, had an average height of 10 feet.

Although this plant, because of the use made of the fruit by birds, has been widely promoted for wildlife plantings, its poor adaptability to field-planting conditions makes it generally unsuited for conservation purposes.

Red mulberry (*Morus rubra*)

Results with red mulberry have been even poorer than with the preceding species. Survival has been consistently very poor. Of seven plantings measured in areas from New York to Maryland and West Virginia, none had more than a few scattered plants remaining after 5 to 8 years. This is typical of results generally in the Northeast. The few plants that lived made fair to good height growth ranging from 5 feet in Steuben County, N. Y., to a maximum of 18 feet in Westmoreland County, Pa. None fruited and none reproduced beyond an occasional basal shoot close to the main stem. The plant seems to be unsuited for use in conservation plantings.

Virginia creeper (*Parthenocissus quinquefolia*)

This climbing vine was used widely in gully, border, and road-bank plantings from 1936 to 1942. Results in 17 plantings in New York, Pennsylvania, Delaware, and Maryland, 5 to 9 years after planting, were uniformly poor. Only 5 of the plantings had survivals of 70 percent or better, and most of the others were complete failures.

Most of the plantings were in very poor soil. Initial survival was usually good but the plants gradually died as the result of unfavorable soil conditions. For example, a gully planting in piedmont soil of northern Delaware had a survival of 90 percent and a growth averaging 40 inches by the end of the third season. After 7 years, the survival was down to 50 percent and average growth was only 46 inches. Most plants died in 7 to 9 years.

American plum (*Prunus americana*)

Numerous plantings of the native American plum were made in borders and wildlife areas between 1937 and 1941. Performance records on 12 plantings in New York, West Virginia, and Delaware showed that survival was satisfactory in 7, which included plantings in each state. Growth was generally poor, the height of all plantings averaging 43 inches in 5 to 8 years. The single-stem character and sparse branching provided very thin cover. No planting approached domination of the site. None had reproduced. A few plants in two plantings bore some fruit the fifth year.

General observations on other plantings in New Jersey, Pennsylvania, and Maryland showed similar results.

This species, like others of the *Prunus* genus, is subject to attack from numerous insects and diseases which also attack cultivated fruits. This, together with its poor showing in plantings, makes the species undesirable for use in conservation plantings.

Chinese bushcherry (*Prunus japonica*)

Four tests were made of Chinese bushcherry—one each in New York, Vermont, New Hampshire, and Massachusetts. Survival after 5 years was fair to good but growth was very poor, the average height of the best planting being only 20 inches. The tops of nearly all plants were winter-killed each year and plant vigor steadily declined from year to year.

Manchu cherry (*Prunus tomentosa*)

The results in four plantings in Kent County, Md., though not consistent, were generally poor. Two plantings were total failures. The other two had good survival but height growth averaged only 21 inches in 5 years. All the trial plantings in central New York, southern Delaware, and York County, Pa., were failures.

Additional tests were made in New York, Massachusetts, New Hampshire, and Vermont in 1945. All the Vermont and New Hampshire plantings died. Survival was good in the other two areas but height growth was very poor.

Scrub oak (*Quercus ilicifolia*)

A few plantings of this shrubby oak were made in 1937 in Cattaraugus County, N. Y., Indiana and Lancaster Counties, Pa., and elsewhere. Survival was fair, averaging about 50 percent. In most plantings, height growth was 2 to 3 feet in 8 years. One Lancaster County planting grew to 7 feet in 13 years. The plantings spread a little by stolons but none approached site domination. A few plants produced acorns by the eighth year.

This scrub oak does not have enough desirable attributes to warrant its use in farm plantings. Even when planted only for game-food purposes, only mediocre results can be expected.

Flameleaf sumac (*Rhus copallina*)

Four test plantings in New York, Massachusetts, and Pennsylvania had poor survival and growth in 5 years. The plant does not seem to be well adapted for use in farm-conservation plantings.

Hybrid sweetbriar rose (*Rosa eglanteria* hyb.)

This tall, erect, thorny rose was planted fairly extensively in wildlife borders and in gullies between 1938 and 1941. The seeds for the plants were collected from several localities in south-central New York as "native wild rose"—probably hybrids of *Rosa eglanteria, Rosa blanda,* and possibly others. Periodic measurements of 12 plantings in New York, Pennsylvania, Delaware, and West Virginia showed that height growth was fairly good but survival highly variable. Only 6 of the 12 plantings, all in Pennsylvania or southward, had good survival.

Height growth in 5 to 7 years was generally about 50 inches. One 13-year-old planting was 8 feet high. Although many plantings in both Pennsylvania and Delaware met with early success, the results of other plantings in the same areas were poor.

Many plantings yielded fair crops of fruit after the third year and some of the better plantings achieved fair domination of their sites. The dying out of canes while the plants were still fairly young gave plantings an unsightly appearance.

There seems to be little justification for the use of this plant in view of the availability of multiflora rose, a greatly superior plant.

Peafruit rose (*Rosa pisocarpa*)

Test plantings of peafruit rose in central New York, northern New Jersey, and southern Pennsylvania have been failures. Although initial survival was fair, less than half the plants lived through the first 5 years. The plants made poor height growth, the best growth averaging 28 inches. Form and vigor likewise were very poor, indicating lack of hardiness and poor adaptability to low-grade soils.

Trailing raspberry (*Rubus parvifolius*)

Trailing raspberry, as its common name implies, has a strong tendency to spread over the ground. Plantings were made in a number of large gullies in Delaware and southeastern Pennsylvania in 1937 and 1938, using stock of a selected strain from the State Experiment Station at Geneva, N. Y. All plantings were initially successful, with more than 70 percent of plants surviving. Six of the plantings have been measured periodically. After the eighth year it was impossible to identify the original plants because of their profuse layering. The plants blanketed the site well, forming a low-storied ground cover. In one instance, Halls honeysuckle came in later and overtopped the raspberry.

Of six additional plantings made after 1945 in New York, Vermont, Massachusetts, and Maine, five were failures. Three others in southern Pennsylvania, Maryland, and West Virginia were initially successful.

Average length of growth in the successful plantings, as measured from the nearest crown, ranged from 66 to 120 inches. Fruit yields were consistently poor.

This species has little in its favor for use in conservation plantings. Although its trailing habit lends itself to use on road banks and similar steep areas, other plants are better suited for such sites.

Willows (*Salix* sp.)

Among the shrub willows tested for streambank and shore-line plantings, aside from purple-osier willow, previously described and recommended for this use, were several which generally had poor survival and growth or other characteristics making them unsuited for field use. These are coyote willow (*S. exigua*), streakwood willow (*S. holosericea*), Hooker willow (*S. hookeriana*), and *S. myrsinifolia*. (*Salix discolor, S. hastata,* and *S. pieroti,* are still under observation).

Ten species of tree willows were observed to determine their suitability for streambank planting. Two of these—*S. alba* and *S. fragilis*—had been used in actual streambank-control work before the importance of natural resilience in plants for streambank cover had been fully determined. These relatively rigid types of willow were planted in the expectation that the stems could be kept sufficiently resilient for streambank use through frequent maintenance cuttings. Later experience, however, proved such treatment to be impracticable. Hence, none of the tree willows are recommended for streambank planting despite the fact that several of them can be planted and grown successfully.

American elder (*Sambucus canadensis*)

American elder was planted in several places in New York and New Jersey from 1937 to 1939. Of six plantings observed periodically and measured for 8 years, only one, located in a seepy gully near Attica, N. Y., was a success. Survival was excellent and the height in 7 years averaged 91 inches. The other plantings were all poor, height growth being slow and survival very low in three of them. None had approached site domination or provided good wildlife cover.

There was no reproduction of any kind and no fruiting except in the single successful planting.

Despite the well-known quality of the fruit of this shrub for household purposes, the plant occurs so abundantly in most parts of its natural range that there seems to be little occasion for including it in planned farm-planting programs.

American mountainash (*Sorbus americana*) and European mountainash (*S. aucuparia*)

Neither of these species gave dependable planting results. Some plantings had good survival and grew well but most of them had poor survival and growth.

The plants were used quite generally in the Northeast from 1938 to 1944. Nine plantings in New York and two plantings in Maryland that were 5 to 8 years old were periodically measured. In three of these, sur-

vival was 70 percent or more; in most of the others only a few scattered plants survived.

Average height growth in 11 plantings was only 27 inches. As both species have a nonspreading treelike form, none of the plantings provided much cover. None reproduced in any way, and none fruited.

European bladdernut (*Staphylea pinnata*)

Ten test plantings of European bladdernut in New York, New Jersey, and Pennsylvania were failures. The few that had some survival did not make much growth. The best plants were only about 20 inches high at the end of 6 years and most plants had made no growth whatever in the 6-year period.

Common snowberry (*Symphoricarpos albus*)

Common snowberry, which is similar in many respects to coralberry, might be used in the same way as coralberry, although experience indicates that it is a less satisfactory plant. Five plantings observed in New York and Pennsylvania had only fair initial survival and growth. Height at the end of 6 to 9 years was about 2 feet, there had been no reproduction, and site domination was poor.

Canada yew (*Taxus canadensis*)

Of five test plantings in New York, three were complete failures. The other two had fair to good survival but had made little growth in 11 years.

Mapleleaf viburnum (*Viburnum acerifolium*)

Mapleleaf viburnum, being naturally an understory plant in woodlands, is unsuitable for open-field plantings. Almost all the plants in all plantings died. The few that survived, though growing mainly in shaded spots, failed to develop into a good type of erosion-control or wildlife cover. Scattered plants grew 3 to 4 feet high and matured some fruit in 6 or 7 years. All were rather sparsely branched. There is little likelihood of this species being useful in conservation plantings.

Frost grape (*Vitis vulpina*)

Frost grape was the only species of grape tried in test plantings in the Northeast. Of six 1938 plantings measured, four were complete failures. The few plants that survived in the other two had grown fairly well. One 7-year-old plant remaining in a gully near New Bethlehem, Pa., was 80 inches long, and the average length of four plants in a gully near Bath, N. Y., was 110 inches.

More research is needed on the grapes for wildlife plantings, but the results in these plantings have been so poor that there seems to be little chance of this grape finding a useful place in conservation plantings. They do not provide good erosion control and seem unsuited for use in borders, hedges, and windbreaks because of their climbing habit. They are unacceptable to the farmers in many areas for these reasons.

SHRUBS TESTED INSUFFICIENTLY TO WARRANT MAKING RECOMMENDATIONS

The program of testing shrubs not used heretofore in connection with conservation practices is a continuing one. Not only have the past 15 years seen rapid changes in the recommendations made for shrub plantings in conservation programs, but additional revisions may be anticipated in the future as experience is gained with shrubs now in use and with others still to be tried.

The following notes are for species now being observed but for which there is not enough information to warrant either recommending the species for field use or discontinuing the tests as failures. Tests on these plants are continuing.

Berberis koreana	Korean barberry
Campsis radicans	Common trumpetcreeper
Castanea crenata	Japanese chestnut
Castanea mollissima	Chinese chestnut
Chaenomeles lagenaria	Common floweringquince
Cornus rugosa	Roundleaf dogwood
Cotoneaster microphylla	Rockspray cotoneaster
Crataegus crusgalli	Cockspur hawthorn
Crataegus macracantha	Spike hawthorn
Crataegus monogyna	Singleseed hawthorn
Crataegus pedicellata	Ontario hawthorn
Diervilla lonicera	Dwarf bushhoneysuckle
Elaeagnus commutata	Silverberry
Elaeagnus multiflora	Cherry elaeagnus
Lespedeza formosa *L. kiusiana* *L. maximowiczi*	Shrub lespedezas
Lonicera morrowi	Morrow honeysuckle
Lonicera quinquelocularis	Mistletoe honeysuckle
Malus baccata	Siberian crabapple
Malus floribunda	Japanese flowering crabapple
Malus sieboldi	Toringo crabapple
Malus zumi	Zumi crabapple
Physocarpus opulifolius	Common ninebark
Prunus maritima	Beach plum
Rhamnus davurica nipponica	Nippon buckthorn
Rhus aromatica	Fragrant sumac
Rosa acicularis nipponensis	Nippon prickly rose
Rosa amblyotis	Erectprickle rose
Rosa gymnocarpa	Baldhip rose
Salix discolor	Pussy willow
Salix hastata	Halberd willow
Salix pieroti	Pierrot willow
Viburnum lantana	Wayfaringtree viburnum

Korean barberry (*Berberis koreana*)

Two test plantings of Korean barberry have been observed for 3 years. One, at the Arnot Erosion Control Experiment Station in New

York, has had poor survival and no new growth. In the other, in northern Vermont, height growth has averaged 11 inches and all plants have survived two growing seasons.

Common trumpetcreeper (*Campsis radicans*)

Ten plantings observed for 2 or 3 years hold a fair promise of producing successful stands. The plant, which is being tested in areas ranging from Delaware and Maryland to Vermont and Maine, seems to be climatically adapted in all the places where plantings have been made. Survival has been very good except in a Maine planting damaged by deer. Two-year growth has been only about 12 inches; the best average 3-year growth of 81 inches was made by a Massachusetts planting.

Japanese chestnut (*Castanea crenata*)

Six test plantings, observed over a period of 3 to 6 years, have all given unsatisfactory results. No plants survived in Vermont, which is evidently too far north, but a few plants lived in New York and West Virginia. Survival in New Jersey and Massachusetts was satisfactory but growth was poor, unfavorable climatic conditions and poor soil appearing to be the limiting factors. Final conclusions cannot yet be drawn on the suitability of the species for practical field planting.

Chinese chestnut (*Castanea mollissima*)

Thirty-three plantings from 2 to 9 years old, located in eight States from Delaware and West Virginia to Vermont and New Hampshire, have been under observation. The plantings in New York and northern New England were severely winter-damaged.

Survival generally has been satisfactory, exceeding 70 percent on 23 sites. Height growth in 7 to 9 years has ranged from 2 to 8 feet. The plants generally have shown lack of vigor, probably because of the poor soils of the planting sites. Few plants have developed good growth form and only a very few have produced good nuts. No plantings have achieved domination of the site.

The results to date, which are based on the best available varieties of this chestnut, are not conclusive enough to justify recommending the species for field conservation plantings in the Northeast. (No attempt is made here to evaluate this and the preceding species for orchard uses).

Common floweringquince (*Chaenomeles lagenaria*)

A selected variety of common floweringquince is being tested in seven plantings in areas ranging from Vermont to West Virginia. Survival after three seasons has been excellent with the exception of a planting on the Maryland coastal plain which failed entirely. Growth has been slow, averaging from 12 to 36 inches in 3 years.

Roundleaf dogwood (*Cornus rugosa*)

Seven test plots located in Maine, Vermont, Massachusetts, New York, Delaware, and Maryland have been observed for 2 years. The

northern plots had fair to good survival; the two southern ones, poor survival. Severe browsing by deer destroyed one of the Maine plantings. Height growth has averaged only 10 to 15 inches in 2 years.

Rockspray cotoneaster (*Cotoneaster microphylla*)

Of six trial plantings 2 years old, three were complete failures. Survival in the others has been satisfactory but there was no new growth in the first 2 years. Although final conclusions cannot yet be drawn, the results thus far have not been encouraging.

Cockspur hawthorn (*Crataegus crusagalli*)

One test planting in York County, Pa., after 10 seasons, has had very good survival, average growth of 6 feet, and fair plant form. This species may have possibilities for wildlife use on game lands, but its widespread use for conservation planting will depend on a showing of superior qualities sufficient to overcome the disfavor in which all hawthorns are held by farmers in general.

Spike hawthorn (*Crataegus macracantha*)

Of two plantings made near Newark, Del., one was a complete failure. The other, on a site where other shrubs have done well, had a fair survival at the end of 7 years and an average height of 22 inches. Growth form, however, was poor.

Singleseed hawthorn (*Crataegus monogyna*)

Of four test plantings, one near York, Pa., had poor survival and no height growth at the end of 4 years. Three plantings in central New York, on the other hand, have had very good survival. Height growth was 13 inches in 4 years and 14 and 24 inches in 5 years, respectively; but all the plants had rather poor growth form.

Ontario hawthorn (*Crataegus pedicellata*)

A test planting near York, Pa., at the end of 4 years showed poor survival and practically no growth. Another in central New York in the same time has had very good survival, average height growth of 19 inches, but only fair growth form.

Dwarf bushhoneysuckle (*Diervilla lonicera*)

Two plantings in raw gullies in New York had 70-percent survival and height growth of 36 inches in 12 years. They had reproduced well by stolons, dominated the sites fairly well, and produced good seed yields.

Silverberry (*Elaeagnus commutata*)

Of six test plantings that have been observed for 2 and 3 years, three have failed completely and none of the others had good survival. There

was no appreciable growth in three seasons. However, since the planting stock used was of small size, the poor initial results fail to provide an adequate basis for determining the true value of the species and further testing is desirable.

Cherry elaeagnus (*Elaeagnus multiflora*)

Cherry elaeagnus closely resembles the autumn olive recommended for general use. Its fruit, however, is considerably larger and the shrub offers a possibility of furnishing useful human food as well as food for wildlife. The fruit is oblong, about ¾ inch long, and has a pleasant acid flavor. The shrub is a little shorter than autumn olive and the branch tips lack the spiny tendency of the taller species.

Eleven test plantings have been observed for 2 to 5 years. All but one had excellent survival and in the majority of the plantings survival exceeded 90 percent. Height growth has averaged 28 inches in 3 years and 52 inches in 5 years. Plant form has been good in all cases. The greatest height growth—80 inches—was attained in 4 years. No plants fruited during the brief period of observation. The results of the plantings, which were located in Vermont, Massachusetts, New York, New Jersey, Pennsylvania, and West Virginia, gave no evidence of geographical or soil-type limitations.

This species appears to have promise for conservation planting but continued observation for several years is needed before definite conclusions can be reached.

Shrub lespedezas (*Lespedeza formosa, L. kiusiana*, and *L. maximowiczi*)

These three shrub lespedezas have not been tested adequately to warrant drawing final conclusions. Plantings of Formosa lespedeza (held by some authorities to be identical with *L. thunbergi*) have been observed in eight areas ranging from Vermont to West Virginia. An 11-year-old planting in York County, Pa., had entirely disappeared after a promising early start. The other tests, which have been carried out over periods of 2 to 4 years, show good initial survival but great differences in height growth. Although the normal maturing date is at least as late as that of bicolor, the selected strains used in the more recent plantings may mature earlier. The species has not shown much promise for general use to the present time.

L. maximowiczi and *L. kiusiana* have been under test only 2 years and require further observation before comparisons can be made with other shrub lespedezas.

Morrow honeysuckle (*Lonicera morrowi*)

A central New York test planting at the end of 9 years had good survival and growth of 20 inches, but only fair plant form. A 10-year-old planting in York County, Pa., had good survival, a growth of 108 inches, good form, and good fruit yield.

Mistletoe honeysuckle (*Lonicera quinquelocularis*)

Two test plantings in central New York and York County, Pa., respectively, had good survival. At the end of 6 years, height growth in the New York planting was 30 inches. The form of the plants graded fair, and a little fruit had matured. In the Pennsylvania planting, growth averaged 144 inches in 11 years, plant form was good, fruit yield was high and the planting had dominated the site.

Siberian crabapple (*Malus baccata*)

Plantings of Siberian crabapple made in 1937 and 1938 have generally proved successful. Measurements have been made in nine plantings in Maryland, Delaware, Pennsylvania, New York, Vermont, and Maine. All but the Maine and Vermont plantings had excellent survival. In Maine, the poor results were due to excessive deer browsing but even under this adverse handicap one-third of the plants continued to live. In Vermont, survival was 50 percent; and in the Adirondacks of New York, under similar conditions, it was 90 percent. A gully planting in Delaware has grown, on the average, only 38 inches in 7 years; but considering the raw, sterile soil of the planting site, thrifty growth could not be expected. Two Lancaster County, Pa., border plantings had an average growth of 13 feet in 13 years, some trees reaching a height of 25 feet. Both plantings fruited heavily beginning with the eighth season, and new seedling plants had sprung up within the borders. Rabbits had browsed the plantings without causing severe damage. Growth rate was 4 feet in 5 years, 6 feet in 6 years, and 7½ feet in 8 years. Plants of the *mandshurica* variety included in the planting thrived equally well.

Japanese flowering crabapple (*Malus floribunda*)

One farm planting in central New York had good survival and an average height of 5 feet at the end of 5 years. Younger test plantings have also shown promise. Because the fruit stays on the plant throughout the winter and is particularly palatable to pheasants and other farm game, this crabapple may prove highly useful in conservation plantings. The practicability of field plantings, however, needs to be definitely determined.

Toringo crabapple (*Malus sieboldi*)

A number of plants of Toringo crabapple were planted along with Siberian crabapple in Lancaster County, Pa., in 1937. Survival was high and height growth was 10 to 13 feet in 13 years. Good crops of fruit were produced after the eighth season. Two additional trial plantings showed 90- to 100-percent survival at the end of three or four growing seasons. The average height was 22 inches in 4 years.

Zumi crabapple (*Malus zumi*)

Two plantings at the end of two growing seasons showed perfect survival and a height growth of 9 inches.

Common ninebark (*Physocarpus opulifolius*)

Two New York plantings, each 11 years old, had survivals of 75 and 90 percent and average heights of 72 and 60 inches, respectively. A third New York planting on a similar site, however, had failed by the end of 5 years.

Beach plum (*Prunus maritima*)

A test planting in central New York at the end of 10 years had 70-percent survival, 20 inches average growth, and sparse branching. In York County, Pa., results were similar except that the growth was only 14 inches. Rabbits had caused some damage by browsing. At Beltsville, Md., in coastal-plain soils, an excellent mature stand was obtained by direct seeding. Ten other plantings had fair to good survival. In upland soils of Vermont, New York, Pennsylvania, and West Virginia, height growth was very poor. Along the coastal areas of New Jersey and Delaware the height of plants at the end of 6 years averaged 5 to 10 feet.

This species offers promise for conservation plantings in its native Coastal Plain.

Nippon buckthorn (*Rhamnus davurica nipponica*)

Three plantings had good survival but slow growth. Near York, Pa., height growth averaged 37 inches at the end of 6 years; at Newark, Del., it was 43 inches in 7 years; and at Attica Center, N. Y., 28 inches in 7 years. In form, the plants generally were single-stemmed and fairly sparsely branched. A few plants fruited the seventh year. Further study is needed to definitely determine the value of the species for conservation planting.

Fragrant sumac (*Rhus aromatica*)

Observations of nine plantings in areas ranging from Maine to West Virginia showed that survival at the end of 5 years was 70 percent or more except in one Vermont planting. Average height growth ranged from 12 to 24 inches. Fruit in small quantities first appeared in the fifth year.

Nippon prickly rose (*Rosa acicularis nipponensis*)

Four plots in Maine, Vermont, New York, and Maryland have shown uniformly high survival and fairly good growth during the first 2 years.

Erectprickle rose (*Rosa amblyotis*)

Erectprickle rose is being tested in Maine, Massachusetts, Vermont, New York, Pennsylvania, Maryland, and West Virginia. Survival has generally ranged from fair to excellent. Growth during the first 3 or 4 years has been slow and plant form generally poor. One planting fruited in its second season.

Baldhip rose (*Rosa gymnocarpa*)

Seven test plantings were made in Maine, Vermont, New York, Pennsylvania, Delaware, Maryland, and West Virginia. All but the Delaware planting showed good survival in 3 to 4 years. Height growth was consistently poor but the plants stoloned well.

Pussy willow (*Salix discolor*)

Two test plantings—one each in New York and Pennsylvania—had good survival and height growth in 5 years. Near Mt. Gretna, Pa., growth reached 13 feet; near Ithaca, N. Y., 5 feet. The plants had good form and showed evidence of ability to dominate the planting site. The behavior of this species when grown under conditions of severe streambank erosion has not yet been determined.

Halberd willow (*Salix hastata*)

Halberd willow is being tested on moist sites in Maine, New York, and Pennsylvania. Of five plantings under observation, survival has been good in four and growth has been fairly satisfactory in three. In an 8-year-old planting, the oldest one observed, the plants showed excellent ability to recover from browsing by beaver, having made a dense ground cover through stoloning. Another planting, in an area heavily populated by deer, had been completely destroyed by browsing.

Pierrot willow (*Salix pieroti*)

Although an observational planting in New York was a failure, the good survival and growth of two other such plantings in Pennsylvania indicate some promise of value in this species for conservation planting. The planting in York County was 8 feet high at the end of 4 years, the one in Lebanon County 22 feet high after 8 years.

Wayfaringtree viburnum (*Viburnum lantana*)

In five test plantings in New York, Massachusetts, New Hampshire, and West Virginia, survival at the end of 3 to 5 years was fair to good. Growth was slow, the best being 28 inches in 5 years.

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